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ANXIETY, PHYSIOLOGICALLY AND PSYCHOLOGICALLY MEASURED, AND ITS CONSEQUENCES ON MENTAL TEST PERFORMANCE.

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EXPERIMENTS WERE CONDUCTED TO DETERMINE THE EXTENT TO WHICH (1) EXPERIMENTALLY INDUCED ANXIETY INFLUENCES ABILITY TEST PERFORMANCE AND (2) THE VARIOUS PHYSIOLOGICAL AND PSYCHOLOGICAL MEASURES OF ANXIETY ARE RELATED. HIGH SCHOOL SENIORS WERE ADMINISTERED THE FOLLOWING MEASURES OF ANXIETY--(1) S-R INVENTORY OF ANXIOUSNESS, (2) AFFECT ADJECTIVE CHECKLIST, (3) TEST ANXIETY SCALE, AND (4) BENDIG'S SHORT FORM OF THE MANIFEST ANXIETY SCALE. THE 100 PARTICIPANTS WERE ASSIGNED AT RANDOM TO 1 OF 5 TREATMENT GROUPS (3 EXPERIMENTAL, 2 CONTROL), AND STRATIFIED BY SEX AND PROFICIENCY LEVEL. THE EXPERIMENTAL GROUPS RECEIVED ANXIETY-REDUCING, NEUTRAL, OR ANXIETY-PRODUCING INSTRUCTIONS BY TAPE RECORDER BEFORE BEING ADMINISTERED AN ACADEMIC ABILITY TEST. WHILE SUBJECTS WERE PERFORMING ON THE TEST THEIR RESPIRATION RATE AND DEPTH, HEART BEAT RATE, GALVANIC SKIN RESPONSE, SYSTOLIC AND DIASTOLIC BLOOD PRESSURE, PULSE PRESSURE, AND ORAL, FACE, AND FINGER TEMPERATURES WERE TAKEN. ONE CONTROL GROUP WAS USED TO RECORD PHYSIOLOGICAL MEASURES DURING READINGS OF A SCHOOL TEXT INSTEAD OF TAKING A TEST. OTHER CONTROL SUBJECTS TOOK THE TEST, BUT NO PHYSIOLOGICAL MEASURES WERE TAKEN UNTIL THE TEST WAS COMPLETED. RESULTING DATA WERE ANALYZED. ONE OF THE PRINCIPAL FINDINGS WAS THAT EITHER ANXIETY WAS NOT A HINDRANCE TO TEST PERFORMANCE WITHIN THE LIMITS OF THIS STUDY, OR TEST ANXIETY WAS NOT MEASURED SUFFICIENTLY BY THE PHYSIOLOGICAL RESPONSES OBTAINED. IN ADDITION, THE VARIOUS PHYSIOLOGICAL AND PSYCHOLOGICAL MEASURES WERE ESSENTIALLY UNCORRELATED. (LP)

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Final Report

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Final Report 31 August 1966

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ABSTRACT

ANXIETY, PHYSIOLOGICALLY AND PSYCHOLOGICALLY MEASURED, AND ITS CONSEQUENCES ON MENTAL TEST PERFORMANCE

This study dealt with physiological and psychological measures of anxiety and their consequences on mental test performance.

Procedures

High school seniors were administered the following psychological measures of anxiety: S-R Inventory of Anxiousness, Affect Adjective Check List, I. G. Sarason's Test Anxiety Scale, and Bendig's short form of Taylor's Manifest Anxiety Scale.

One hundred seniors were assigned at random to one of five treatment groups, and stratified by sex and proficiency level. In three of the five groups, each subject received either anxiety-reducing instructions, neutral instructions, or anxiety-producing instructions.

The three treatment groups were administered the Academic Ability Test concurrent with the recording of the following physiological measures: respiration rate, respiration depth, heart beat rate, galvanic skin response, systolic blood pressure, diastolic blood pressure, pulse pressure, oral temperature, face

temperature, and finger temperature. The other two groups were controls, one for physiological measures and the other for test performance.

Analysis of Data

The basic statistical model for the analysis of the data was a three-way analysis of variance (treatments-by-proficiency levels-by-sex).

The dependent variables were the Academic Ability Test scores and the physiological and psychological measures of anxiety. Analysis of covariance using the same factorial design was computed for the ability test scores with the initial level of anxiety held constant. Correlational analyses were also performed.

Findings and Conclusions

1. No significant differences between treatment groups were evidenced for test performance, with or without the initial anxiety level held constant. There were significant interactions between sex and the anxiety stimuli (instructions) for the total and mathematical scores on the ability test when the initial level of anxiety (prereadings of physiological measures) was held constant. Performance of the girls under anxiety-producing instructions surpassed that of the

boys under the same instructions.

2. Among physiological measures, respiration rate alone was significantly different among the treatment groups. This fact suggests that the instruction did not manipulate differential anxiety in the examinees.

3. There were no significant differences between the proficiency levels for physiological responses.

4. Face temperature, finger temperature, systolic blood pressure, and pulse pressure were significantly higher for the boys than for the girls. Respiration rate and oral temperature were significantly higher for the girls than for the boys. (Higher measures do not necessarily indicate greater anxiety) There were no significant differences between the sexes for: diastolic blood pressure, GSR, respiration depth, and heart beat rate.

5. Pulse pressure was significantly related to: (a) systolic blood pressure, (b) diastolic blood pressure, (c) respiration rate, and (d) oral temperature. Other significant correlations were: respiration depth with heart beat rate, and systolic blood pressure; diastolic blood pressure with oral temperature; and face temperature with finger temperature.

6. All psychological measures were positively and moderately interrelated.

7. The physiological and psychological measures were essentially uncorrelated.

8. The TAS and the AACL were significantly related to test performance.

9. Significant correlations were obtained between scores on the Academic Ability Test and the following measures: oral temperature, heart beat rate, pulse pressure, diastolic blood pressure, and respiration rate.

10. Since differences between treatment groups on the ability test were not significant, all groups were pooled to determine a multiple correlation, predicting Academic Ability Test scores from the optimal combination of physiological measures. This too failed to prove significant.

This finding suggests that either (a) anxiety was not a hindrance to test performance within the limits of this study, or (b) test anxiety is not measured by these physiological responses. These findings are independent of the question as to whether anxiety was experimentally manipulated or not.

Kenneth D. Hopkins, Alma C. Chambers
University of Southern California
31 August 1966

CHAPTER I

PROBLEM

For several decades the construct, "anxiety," as a result of the impetus given by Cannon (1929) and Freud (1936), has received attention by psychologists in clinical research with abnormal individuals. More recently, however, anxiety on the basis of theoretical considerations and empirical evidence has been investigated for normal individuals in an examination environment. Teachers and psychologists have repeatedly observed capable individuals whose test performance was not commensurate with their apparent ability. Since test scores play a major role in making decisions about people, these conditions pose a serious problem which deserves consideration.

Statement of the Problem

The problem in this study was to investigate the following questions: (a) to what extent does anxiety influence test performance, and (b) what is the relationship between various physiological and psychological measures of anxiety?

Background of the Study

To assist in making important decisions about individuals, psychologists and educators have made manifold use of a multiplicity of tests. It is possible for results of an examination to alter a person's entire future by causing him to be denied entrance to a chosen pursuit or by their revealing to him the presence of unrecognized abilities.

There are many who share the belief that anxiety affects test performance. Anastasi (1961, p. 51) pointed out that, "children who become over-anxious in a test situation are thereby handicapped in their performance." She concluded that, "test anxiety does interfere with effective learning and test performance." Cowen (1957) believed test anxiety could hide an examinee's underlying potential. Cronbach (1960, p. 54) expressed a similar thought: "When the subject wishes to earn the best score he can, his very desire to do well may interfere with good performance. When one is tense, he commits errors that he would readily detect as such otherwise." According to Thorndike and Hagen (1961, p. 506), "Performance under examination pressure may fail to represent the individual's competence under more relaxed and normal life conditions." S.B. Sarason and Mandler (1952) concluded that it is questionable whether intelligence test scores adequately describe the underlying abilities of individuals who have high anxiety drive in the testing situation.

Since tests play such an important role in making decisions about individuals, the results of performance on them should be as free from contaminating influences as possible. Hopkins (1961, p. 1) writes: "If tests are to have their maximum validity, elements which cause discrepancies between obtained and true scores should be identified and corrective measures sought."

If a noncognitive factor, such as anxiety, causes discrepancies in test performance, it should be investigated. Much of the research in this general area has been correlational, not experimental, and has used paper-and-pencil self-report devices as indices of anxiety. Only this type of anxiety measure has been systematically investigated as a variable concomitant with mental test performance.

Paper-and-pencil self-report devices are dependent upon the voluntary answers by the examinee. These responses are based on the individual's self concept, ideal self concept, and the concept he feels others have of him. In addition, the situation is confounded by the fact that there are some feelings and attitudes that an individual is willing to admit to others, some that he is willing to admit to only himself, and still others that he does not admit even to himself. The true validity of these scales would be difficult to determine.

As S.B. Sarason and Mandler (1952) indicated, two individuals might have the same strong anxiety tendency but differ in their readiness, conscious or unconscious, to reveal it. People vary in methods of defending themselves against experiences of anxiety. The extent to which individuals differ in their admission to emotions combined with the fact that they have no common objective frame of reference from which to indicate their feelings, limits the validity of anxiety scales.

Physiological measures of anxiety are not dependent upon the subject's introspective evaluation of his emotional feelings. Rush (1963, p. 178) observed that measurement of physiological change is the most sensitive and objective method of studying emotions. According to Stevens (1951, pp. 473-477), any final description of emotion must be in terms of a reacting mechanism, confined to the emotional behavior and its underlying mechanism. Verbalization is really only an audible indication of inner feelings; therefore, it seems desirable to work directly with the responses of the body, rather than to depend upon the individual's verbal expression. Jost (1953) found that when the organism was stimulated before the subject responded, there were physical changes within him. The body, by its responses, is able to answer questions concerning anxiety that the intellect might not be willing to admit.

Another difficulty in research on anxiety has resulted from the use of only a single physiological measure of anxiety, as in the study of Winter and his associates (Winter, Ferreria, and Ransom, 1963). Even when multiple measures have been used, as in Smith and Wenger's (1965) investigation, the concern has been with the anxiety measures *per se*, not with the relationship of anxiety and test performance.

According to Ruebush (1963, p. 500), relatively little is known concerning the biological antecedents and correlates of anxiety in children. It is evident that there is need for the present experimental study of test anxiety using multiple physiological and psychological measures and resultant performance on an ability test.

Operational Definitions

Test Anxiety

Test anxiety, in this study, refers to physiological response on the following measures: respiration rate, respiration depth, heart beat rate, galvanic skin response, systolic blood pressure, diastolic blood pressure, pulse pressure (S-D), oral temperature, face temperature, and finger temperature; and by the scores on the following psychological measures given prior to the examination: Endler, Hunt and Rosenstein's S-R Inventory of Anxiousness (1962) (S-RI); Zuckerman's Affect Adjective Check List (1960) (AACL); Irwin G. Sarason's Test Anxiety Scale (TAS); and Bendig's (1956) short form of the Taylor Manifest Anxiety Scale (1953) (MAS).

Initial Level of Anxiety

The initial level of anxiety was recorded as the prereadings for the above physiological measures taken before the anxiety stimuli were presented.

Ability Test

The ability test, used as a dependent variable, was the Cooperative Academic Ability Test (AAT)-Form "A" published by the Educational Testing Service.

Mathematical, verbal, and total scores were obtained.

Experimental Treatments or Test Instructions

Test instruction is the critical independent variable, and refers to the experimental test instructions designed to elicit differences in anxiety. Three kinds of test instructions were presented: anxiety-reducing, neutral, and anxiety-producing instructions. In this study the terms experimental groups, treatments, treatment groups, and instruction groups will be used interchangeably. A copy of the three types of instructions used is provided in Appendix A.

Hypotheses

Hypothesis One

Anxiety will influence test performance in the following ways:

A. Anxiety-reducing test instructions will result in highest levels of performance on an ability test.

B. Neutral test instructions will result in medium levels of performance on an ability test.

C. Anxiety-producing instructions will result in lowest levels of performance on an ability test.

Hypothesis Two

The degree of anxiety elicited by the instructions will influence test performance in the following ways when the initial level of anxiety is held constant:

A. Anxiety-reducing test instructions will result in the highest level of performance on an ability test.

B. Neutral test instructions will result in medium levels of performance on an ability test.

C. Anxiety-producing instructions will result in lowest levels of performance on an ability test.

Hypothesis Three

The degree of anxiety elicited by the instructions will influence physiological responses during test performance in the following ways:

A. Anxiety-reducing test instructions will result in the lowest physiological responses.

B. Neutral test instructions will result in medium responses.

C. Anxiety-producing instructions will result in the highest physiological responses.

Hypothesis Four

There will be no difference in physiological responding between high and low proficiency level groups.

Hypothesis Five

Boys will have higher physiological measures than girls for face temperature, finger temperature, systolic blood pressure, diastolic blood pressure, and pulse pressure. Girls will have higher measures than boys for oral temperature, respiration rate, respiration depth, heart beat rate, and GSR.

Hypothesis Six

There will be significant relationships within each treatment group among the following physiological measures of anxiety: respiration rate, respiration depth, heart beat rate, GSR, systolic blood pressure, diastolic blood pressure, pulse pressure, oral temperature, face temperature, and finger temperature.

Hypothesis Seven

There will be a positive relationship between the following psychological measures of anxiety: S-R Inventory of Anxiousness, Affect Adjective Check List, I. G. Sarason's Test Anxiety Scale, and Bendig's short form of Taylor's Manifest Anxiety Scale.

Hypothesis Eight

Within each treatment group the Affect Adjective Check List, administered prior to the ability test, will have a positive relationship with the scores on the same measure obtained immediately following the anxiety instructions.

Hypothesis Nine

Within each treatment group there will be significant relationships among physiological and psychological measures of anxiety.

Hypothesis Ten

Within each treatment group there will be significant relationships between psychological measures of anxiety and scores on the Academic Ability Test.

Hypothesis Eleven

Within each treatment group there will be significant relationships between physiological measures of anxiety and performance on the ability test.

Limitations of the Study

1. This study was limited to 100 seniors in one school; however, since the school closely parallels

the national parameters for the California Test of Mental Maturity (CTMM) and the Iowa Test of Educational Development (ITED), it should have meaningful generalizability.

2. Due to the imposed limitations of the equipment, an unnatural testing situation was necessitated. These conditions may limit generalizability. However, since these conditions were common to all groups, their influence on the study should be minimized. In addition, the possible influence of this factor can be assessed due to the inclusion of one group of examinees on whom physiological measures were not included.

3. Letters of approval from the parents of those taking part in the study were required by the school. This requirement somewhat restricted the selectivity of the sample, which in turn might lead to some lack of generalizability of the findings. To the extent that approval introduced a selective factor in the subjects, the results may not be representative.

Significance of the Study

There are profound differences among the views of psychologists as to what is meant by the concept of anxiety. One's theoretical approach to anxiety largely determines the method used to measure it. Thus, a knowledge of the relationship of the results of the various types of assessment should help to modify and refine the theoretical concept of anxiety. Getzels and Jackson (1963, pp. 574-576) point out that definitions of the inordimately elusive concept of personality are often contradictory, and that observations based on one definition will contradict observations based on another definition. According to them, the more common definitions fall into three main categories: behavioral, social stimulus, and depth. The present study investigated the behavioral definition of anxiety by using both the self-report (psychological) and performance (physiological) types of measures. The use of multiple measures assists in clarifying the concept of anxiety by providing a description of how bodily responses in an anxiety situation relate to the individual's reports of the anxiety he experiences. The investigation also shows how these self-reports of anxiety, developed around various concepts of anxiety, relate to one another; and how performance measures of physiological responses relate to one another. Finally, the investigation attempts to demonstrate the influence of anxiety on mental test performance under varying experimental conditions.

Preview

The remainder of the investigation will be organized in the following manner:

Chapter II presents a review of the literature related to the study under investigation. Various concepts of anxiety will be examined, and research pertaining to the instruments used will be considered.

Chapter III provides reports of empirical investigations showing the relationships between testing variables and measures of anxiety.

Chapter IV describes the sample, instruments, procedures, and the statistical procedures used in analyzing the data.

Chapter V presents the results of the investigation in terms of the hypotheses.

Chapter VI summarizes the study, states conclusions revealed by the results of the investigation, and presents recommendations for further study.

CHAPTER II

REVIEW OF THE LITERATURE ON ANXIETY

The purpose of this chapter is to review briefly the literature concerning various concepts of anxiety and the literature on the instruments used for the measurement of anxiety.

Anxiety

Theories of Anxiety

The twentieth century has been called the age of anxiety. (Dickel & Dixon, 1957). Americans spend over ten billion dollars a year on liquor and buy hundreds of tons of tranquilizing drugs (Coleman, 1964, pp. 2, 3), and still anxiety remains as one of the most perplexing problems of our day. The concept of anxiety is nebulous. It has been studied by a great many minds and approached from a variety of points of view; e.g., the psychoanalytical (Freud, 1936), physiological (Wenger, 1957; Lacey & Lacey, 1962; Martin, 1961), psychological (I.G. Sarason, 1960; Taylor, 1953), and learning theory (Mowrer, 1950).

In fact, the definition of anxiety varies widely among authors, depending upon theoretical framework, empirical studies, and assumptions (Ruebush, 1963, p. 461).

Until the time of Freud and other "depth" psychologists, the problem of anxiety resided in the domain of philosophy. According to Freud (1936, pp. 90-99), anxiety is, "a specific state of unpleasure accompanied by motor discharge along definite pathways." According to him, it arises as a response to a situation of danger, and will be regularly reproduced thenceforward when such a situation recurs. He regarded it as an expression of helplessness and a reaction to the perception of the absence of the love object.

According to the Psychiatric Glossary (American Psychiatric Association, 1957, p. 18) anxiety is, "apprehension, tension or uneasiness which stems from the anticipation of danger, the source of which is largely unknown or unrecognized." Freud (1936, pp. 149-150) also saw anxiety as the anticipation of danger, helplessness, discomfort, or as a reminder, created by a present situation, of a traumatic condition previously experienced. He implied that the danger signal may produce an infinite variety of reactions that are unlike the one that occurred in the actual trauma of which the signal is premonitory (Mowrer, 1950, p. 20). Pavlov's findings were similar to those of Freud, but according to his hypothesis, a danger signal (the conditional stimulus) elicits essentially the same movement reaction that was previously produced by actual trauma (the unconditioned stimulus) (Pavlov, 1928, pp. 14, 52).

Rank (1929, p. 11) viewed anxiety as resulting from the birth trauma. Thus, a normal human being requires his entire lifetime to recover from this first intensive trauma. Freud (1936, pp. 93-97) did not agree with Rank that anxiety develops as a result of the birth trauma because anxiety is experienced by all organisms, certainly all higher ones, but not all organisms experience birth. In accordance with Rank's line of thought, as time, by increasing age, separates the individual from the birth event, anxiety would be expected to decrease. This relationship with time and test anxiety, however, does not hold true; for test anxiety tends to increase with years (Cronbach, 1960, p. 54). May (1950, pp. 49-51) points out that Goldstein (1938), considered anxiety to be, the subjective experience of the individual in a catastrophic condition. This catastrophic condition is that particular danger which threatens the physical or psychological life of the individual. To one student a particular examination may not be a traumatic experience, whereas to another, whose life career depends on passing the examination, it may be a catastrophic experience.

Horney (1939, pp. 194, 201) agreed with Goldstein that what is menaced by a danger-provoking anxiety is something belonging to the essence of the core of the personality. She stated further that anxiety emerges because the safety, security, or an essential value of the individual is endangered. Horney pointed out that in Freud's concept of anxiety in neuroses the source of danger is in the "id" and "superego," but to her, the source is that a safety device of vital importance is endangered.

Anxiety and Fear

Horney (1939, pp. 194, 195) saw anxiety and fear as emotional responses to danger, but she contended that anxiety is characterized in contradistinction to fear by a quality of diffuseness and uncertainty. Even a concrete danger, an earthquake for instance, has something of the horror of the unknown. What is menaced by a danger-provoking anxiety is something belonging to the essence or core of the personality, and the feeling of helplessness toward the danger. According to Horney, the same situation may elicit fear or anxiety. If the person is afraid, but does something in an attempt to remedy the situation, the feeling would be fear. But if he is afraid and helpless to do anything about it, the experienced emotion is anxiety.

The distinction between fear and anxiety, as pointed out by Coleman (1964, pp. 75, 93), is that, "fear tends to protect the organism by leading it to withdraw from dangerous situations," whereas anxiety is aroused by a threat to the adequacy or worth of the self. It is often referred to as "psychic pain," and can be acutely unpleasant. Danger arouses fear, but threat arouses anxiety.

Martin (1961) proposed that the construct of anxiety is similar, perhaps identical, to the reaction of fear, the neurophysiological basis for which, seem to involve the functions of the posterior hypothalamus and its effects upon the sympathetic nervous system, including the adrenal medulla, the pituitary-adrenocortical system, and perhaps the brain stem and reticular formation.

Marmor (1962) tended to agree with the position held by Martin that, physiologically, fear and anxiety are similar or identical. However, he did point out that the differentiation between anxiety and fear has been a source of frequent discussion with no uniform agreement about it. He stated further: "in general, the term fear is used to refer to reactions to known, tangible and objective dangers, while the term anxiety is reserved for reactions to unknown, intangible and subjective ones." He also stated that fear most often refers to present dangers, whereas anxiety usually refers to anticipated or future ones. In addition, he said that, physiologically, there is no difference between fear and anxiety. Martin (1961) and Marmor (1962) both agreed on the point that the physiological responses of fear and anxiety are similar or identical.

Contrarily, Wolf and Wolff (1943, pp. 110-119) did not find the physiological responses of fear and anxiety to be the same in a study of gastric changes accompanying emotions. With their subject, named Tom, who fed himself through a fistula. They found a marked difference in the reactions to fear and anxiety. In the case of anxiety there was hypersecretion of the gastric juice and a bright redness of the mucous membrane of the stomach because of a superabundance of blood drawn to the area. In fear there was hyposecretion of gastric juice and a paleness of the mucosa of the stomach and a paleness of the face.

According to Rogers (1961, p. 346), sympathetic stimulation of the stomach results in inhibition of motility and secretion; but with parasympathetic stimulation there is increased motility and secretion.

Smith and Wenger (1965) found a sympathetic nervous system response for nine male and two female students prior to their oral doctoral examination. The investigators did not use gastric secretion as a variable, but did observe a decreased salivary output. Wolf and Wolff (1943) found an increased gastric output to be accompanied by an increased salivary output.

May (1950, pp. 203-204) distinguished between fear and anxiety by stating that "the reactions of an organism in times of fear and of anxiety may be radically different, due to the fact that these reactions occur on different psychological levels of the personality." According to May, "the capacity of the organism to react to threats to its existence and its values is, in its general and original form, anxiety." As the organism becomes neurologically and psychologically mature enough to differentiate specific objects of danger, the protective reactions also become specific. The emotion envalued differentiated reactions to specific dangers is fear. The understanding of fear depends upon the understanding of the prior problem of anxiety. May spoke of anxiety as the general, original response to threat on the basic level of the personality: "It is a response to a threat to the 'core' or 'essence' of the personality rather than to a peripheral danger." He infers that anxiety decreases with maturity. This seems to contradict Cronbach's (1960, p. 54) statement concerning test anxiety. As a result of a study of the literature, Cronbach found test anxiety to increase gradually through the school years. According to Cronbach's findings then, as an individual advances in school and in age, he becomes more mature, and the test anxiety which he experiences increases.

Anxiety as a Constructive Force

Mowrer (1945) took the viewpoint that anxiety performs a constructive and positive role in human development. He did not believe it to be the cause of personal disorganization, but rather an outcome or expression of such a state. He pointed out that Kierkegaard also considered that anxiety can be constructive. He stated that not only is anxiety constructive, but also a saving and educative experience (Mowrer, 1950, p. 545).

According to both Marmor and Mowrer the practice of regarding all anxiety as an abnormal experience to be annihilated if possible is a mistake. Marmor (1962) viewed anxiety as an aspect of normal human behavior with a psychological reaction comparable to its physiological analogue, the sensation of pain. "Both are signals to the organism that something is threatening its integrity, and both are essential alerting mechanisms which enable the organism to make the proper adaptive responses." Just as an individual who lacks the capacity to feel pain would be seriously handicapped, so also would an individual who lacks the capacity to feel anxiety. On the other hand, if either tendency becomes excessive, the result can be destructive.

May (1950, pp. 206-208) wrote of normal anxiety and neurotic anxiety. He referred to Freud, who took the position that objective anxiety is inherent in the child and is an expression of the self-preservation instinct with an obvious biological utility.

This biological utility was observed by Janis (1958, pp. 395-412), who noted that his major surgical patients who experienced a moderate amount of preoperative anxiety were significantly less likely to have postoperative emotional disturbances than those who experienced extremely high or extremely low preoperative anxiety. Patients who denied any concern, worry, or anticipatory anxiety; who were constantly cheerful and optimistic; who slept well and showed no observable evidences of tension, were more likely than the others to display postoperative reactions of intense resentment and irritability. A moderate amount of anxiety seemed to help prepare the individual for the coming event.

The Canadian physician Selye (1950), who made an extensive study of stress, likewise held that stress is not always something to be abolished. In his book, The Stress of Life, he implies that living a "full life" requires that a person learn to "enjoy" stress.

In reviewing the previous literature on anxiety, Ruebush concluded (1963) that, according to psychoanalytic theory, the major functions of anxiety in the normal individual are to signal the presence of psychic danger and to signal the withdrawal of an inhibitory response. Different situational stimuli trigger the danger signal for different individuals.

Children differ not only in the number of stimuli that elicit the anxiety but also in the number and strength of unconscious processes, and in the number, strength, and flexibility of their defenses. A child who rarely experiences anxiety may have defense systems which are highly effective in protecting him from experiencing his unconscious drives. Although these defense systems are effective in this limited sense, they may or may not be effective in the role they play in the over-all personality functioning of the child. An inflexible defense system may interfere with other behavioral processes, whereas a flexible system, made up of a variety of defenses, may allow an individual to match the defense with the danger in a way that will maximize protection from danger and will minimize interference with other aspects of intellectual and personality functioning. These latter defenses may be thought of as being learned by the organism.

Anxiety: A Learned Concept

Anxiety is a concept that can be learned. The hypothetical response becomes readily conditioned to stimuli that do not innately elicit the response. Martin (1961) explained that this characteristic complicates any attempt to define anxiety on the basis of stimuli that elicit it since there will be wide interindividual differences among the stimuli that elicit anxiety. According to May (1950, p. 119) Freud considered the capacity for anxiety to be innate in the organism and a phylogenetically inherited characteristic.

A clarification of this conflict in views was made by May (1950, p. 208), who noted that learning psychologists tended to consider anxiety as a learned behavior since each particular fear or focus of anxiety is closely related to the individual's specific experience. On the other hand, neurophysiologists, centering their attention on the given capacities of the organism, tended to assume that anxiety is not learned. May attempted to reconcile this conflict by suggesting that the capacity for anxiety is not learned, but that it is the quantities and forms of anxiety experienced by a given individual which are learned. Most individuals experience anxiety in situations in which his vital values are threatened. These values, however, are shaped primarily by learning.

It might be inferred from Cronbach's writing (1960, p. 54) that anxiety is learned. He stated that it increases gradually through the school years. Mowrer (1950, p. 65) explained that anxiety is a learned response since a reduction in the intensity of anxiety functions as a satisfying state, and thereby brings about the learning of new stimulus-response sequences.

Anxiety as a Drive

Horney (1939) propounded that the concept of "drive" implies some compulsion from within the organism, but that the impulses and desires do not become drives except in such cases as they are motivated by anxiety. She placed anxiety prior to the instinctive drives and the drives themselves as a product of anxiety.

May (1950, pp. 138-140) summarized a number of approaches to anxiety as a drive. He pointed out that, "Freud conceived of environmental influences chiefly as a factor in molding instinctual drives . . ." Freud recognized anxiety as the central problem of neuroses, but did not see the all-pervasive role of anxiety as a dynamic factor driving toward certain goals. The drive property of anxiety was seen by Mowrer (1950, pp. 65, 66), a learning theorist who realized that fear, which he equated with anxiety, is pre-eminently a *drive*, a goad to *action*, and that the ensuing drive reduction can function as a "satisfying state of affairs" which provides emphatic reinforcement of action, and thereby brings about the learning of new stimulus-response sequences. More specifically, he took the position that just as a reduction in hunger, thirst, sex drive, fatigue, lack of oxygen, or the reduction of any other organic need or discomfort tends to reinforce the behavior that brought about the reduction, so a reduction in the discomfort called anxiety is effective in fixating behavior that is associated with it.

Coleman (1964, p. 75) pointed out that anxiety operates as a powerful driving force toward maintenance on a psychological level.

Spence (1956, p. 165) also considered anxiety as a drive. According to him, the general drive level is a function of two motivational variables, appetitional and aversive, both of which operate as emotional drives. The experimental variables determining drive combine in a multiplicative fashion. He assumes that the needs or drive states contribute singly and in combination to the organism's general drive level. This concept of drive is similar to Hull's.

The essence of the position held by the group in Iowa is similar to that held by Mandler and Sarason (1952) in that both groups considered anxiety within the stimulus-response theory, and as Nicholson (1958) pointed out, both attributed drive properties to anxiety.

Mandler and Sarason (1952) held that anxiety can serve as a strong response-produced stimulus with the functional characteristics of a drive. Primarily, anxiety drive elicits responses that tend to reduce the drive. This reduction can be accomplished in either of two ways. In terms of the test situation, anxiety can be reduced by competing responses which are test-irrelevant and may be manifested as feelings of inadequacy, helplessness, heightened somatic reactions, anticipations of punishment, loss of esteem and attempts to leave the test situation. On the other hand, it may be reduced by facilitating responses which are test-relevant and lead to completion of the test or task. The two groups concluded that anxiety in the testing situation is an important variable in test performance. They also stated that, "it is questionable whether intelligence test scores adequately describe the underlying abilities of individuals who have high anxiety drive in the testing situation, particularly since the relation of the type of the test to the test performance seems to play an important determining role." The present study has addressed itself to the task of investigating the influence of anxiety on test performance. A number of instruments, both psychological and physiological, were used to measure the concept of anxiety.

Research on the Instruments Used

Measure of Task Performance

The examination used to measure performance under various instruction stimuli was the Cooperative Academic Ability Test form "A" published by the Educational Testing Service. This test was designed for use with college-bound students. It yields a verbal, a mathematical, and a total score.

Reliability

The Educational Testing Service (1964) provides information concerning the reliability and validity of form "A" of the Academic Ability Test. Internal consistencies of the test, as computed for grade twelve by the Kuder-Richardson Formula 20 were .88 for the verbal score, .92 for the mathematical score, and .94 for the total score (total score 100 items).

Validity

The Educational Testing Service provides data to show the "Correlations between parts of the Academic Ability Test and the Scholastic Aptitude Test were found to be .83 for the verbal score and .96 for the mathematical score." (Educational Testing Service, 1964, p. 11).

Measure of Proficiency

The measure of proficiency was the subject's scores on the Iowa Test of Educational Development, published by Science Research Associates (1962). Although this test is accepted as a high school-level achievement test, it was developed to measure broad intellectual skills, understanding, and ability to apply learned material, rather than recall of specific facts. Buros (1959) indicated that numerous studies have found the Iowa Test of Educational Development to predict college freshman grades to the extent of .50 to .60.

Psychological Measures of Anxiety

Four psychological paper-and-pencil tests of anxiety were used. These were stapled together under the title "Student Survey" and designated as Parts I, II, III, and IV. (A copy of this "Student Survey" is provided in Appendix A.)

Part I: S-R Inventory of Anxiousness (S-R I)

Part I of the Student Survey was the S-R Inventory of Anxiousness by Norman S. Endler of York University, Toronto; J. McHunt of the University of Illinois; and Alvin J. Rosenstein of the Psychological

Corporation, New York City; (Endler, Hunt, and Rosenstein, 1962). The inventory employed fourteen stimuli quantified on a five-step scale ranging from none to very much. The scale was designed to measure responses associated with many experiences by using the same stimuli for each experience. One of the experiences is the examination situation. The test is introduced by the experience the experimenter wishes to investigate. Following is an example of the questions posed.

"You are Taking an Important Examination"

1. Heart beats faster 1 2 3 4 5

Not at all much faster

Two changes in wording were made on the advice of the principal of the high school, who believed that some of the students would not understand the meaning of certain words. Since the test was not meant to measure vocabulary proficiency, and since any expression of response would be invalid without comprehension of the nature of the task, the changes seemed justified. In No. 4, "Feel exhilarated and thrilled," was modified to read, "Feel excited and thrilled," and in No. 10, "Become immobilized," was changed to, "Become unable to move."

Studies by Endler, Hunt, and Rosenstein with the S-R I established the following figures on the test's reliability and validity:

Reliability. From Cronbach's Coefficient Alpha, the reliability was .87 with the S-R I for a final examination in an important course.

Validity. The correlation between the total score of the S-R I for test anxiety plus the ten other experiences investigated was .46 with the Taylor Manifest Anxiety Scale, .66 with the Mandler and Sarason Test Anxiety Quotient, and -.06 with the Palmar-Sweat Index (PSI) (post stress.) As can be observed, there was little discernible relationship between the S-R I paper-and-pencil test and the PSI (Kuno, 1934, 1956).

Part II: Affect Adjective Check List (AACL)

Part II of the Student Survey was the Affect Adjective Check List developed by Marvin Zuckerman (1960). The scale is composed of a list of 61 adjectives with affective connotations collected from Gough's and Nowlis' lists and from a thesaurus. The scale is designed to be checked either the way the individual feels at present (the "today" scale) or the way the individual usually feels under the indicated circumstances (the "general" scale). Only 21 of the adjectives are actually scored. Eleven anxiety-plus words, such as afraid, are scored 1 if marked true and ten anxiety-minus words, such as calm, are scored 1 if marked false.

Reliability. The "today" scale of the AACL has an estimated reliability of .85 by the Kuder-Richardson Formula 20, and .31 for retest. It seems plausible that the responses at a given time were quite stable, but that interpretation of the retest results do not confirm consistent feelings from one time to another. The "general" scale, used to indicate one's general feelings, yielded a reliability of .72 by the Kuder-Richardson Formula 20, and .68 with retest (Zuckerman, 1960).

Validity. The validity coefficient was .28 between the mean of three examination days for the AACL and the MAS. This correlation was not statistically significant. However, for the first examination day the correlation was .40 which was significant at the .05 level (Zuckerman, 1960). The difference between the average of five pre-examination AACL scores for each subject and the examination day AACL scores provided a t of 1.76 which was significant at the .05 level using a one-tailed test (Zuckerman & Biase, 1962). Winter, Ferreira, and Ransom (1963) found the correlation between Taylor's Manifest Anxiety Scale and the AACL to be + .44, $p < .05$, with a one-tailed test but only an insignificant correlation of + .03 between AACL and the PSI which utilized ferric chloride solution and filter paper impregnated with five per cent tanic acid. As can be seen, there was a lack of congruence between the paper-and-pencil test and the physiological measure of anxiety.

Part III: Test Anxiety Scale (TAS)

Part III was the Test Anxiety Scale developed by Irwin G. Sarason (1959) of the University of Washington. The rationale supporting the development of the Test Anxiety Scale (TAS) was based on the observation that individuals are not anxious every minute of the day, and often one can specify the conditions which will lead to an increase in anxiety. Sarason's theory was that a scale designed to measure the anxiety experienced in a testing situation is more related to achievement than a scale designed to measure general or manifest anxiety (Sarason, I. G. 1957, 1960). The questionnaire is composed of sixteen true or false statements describing responses related to examinations. For instance:

1. While taking an important examination, I perspire a great deal.
2. I freeze up on things like intelligence tests and final exams.

Validity

Walter, Denzler, and Sarason (1964) obtained correlations of .43 and .34 between test anxiety and general anxiety for boys and girls in grade ten, and .57 and .37 for high school senior boys and girls. However, the tenth graders were from a higher socio-economic status than were the seniors.

I.G. Sarason (1961) found similar correlations between his Test Anxiety Scale and Taylor's Manifest Anxiety Scale. These correlations were .46 for college men and .53 for college women.

Part IV: Taylor's Manifest Anxiety Scale (MAS)

Part IV is Bendig's (1956) short form of Taylor's Manifest Anxiety Scale (Taylor, 1953). Originally, five clinical psychologists selected items from the Minnesota Multiphasic Personality Inventory that possessed face validity for measuring manifest anxiety. The resulting sixty-five items were then reduced to fifty on the basis of internal consistency. Bendig further reduced the scale to twenty items (1956). This scale imposed such true or false statements as:

1. I believe I am no more nervous than most others.
2. I work under a great deal of tension.

Bendig (1956) shortened the long form of Taylor's Manifest Anxiety Scale on the basis of the results of two studies on the validity of the fifty individual items of the scale. One study by Hoyt and Magoon (1954) had eight clinical psychologists rate 289 college students, whom they had counseled, for manifest anxiety, and selected eighty-eight from the extreme top and eighty-six from the extreme bottom of the rating continuum. The two groups were further dichotomized to provide replicated samples. For both groups, sixteen items discriminated between the high and low anxiety subjects at the .05 level. Seventeen items discriminated in one pair but not the other pair of the sample, and seventeen were not significantly related to clinical ratings of anxiety.

The other study reported by Bendig was conducted by Buss (1955). He had four clinicians rate sixty-four psychiatric subjects on the Manifest Anxiety Scale, and compared the responses of the twenty-two high-anxious and the twenty low-anxious subjects. Fourteen items on the scale discriminated between the high and low anxiety subjects at the .05 level; whereas, thirty-six items did not discriminate between the two groups. Perhaps the reason for only moderate clinical validity was the rationale used for the construction of the scale. The items that clinically defined anxiety were eliminated from the Taylor Manifest Anxiety Scale. From the data reported by Hoyt and Magoon (1954) and Buss (1955), Bendig (1956) selected twenty items to constitute the short form of the Taylor Manifest Anxiety Scale.

Bendig (1956) reported the reliabilities for the short form to be .75 for the males, .74 for the females, and .75 for the total group. Neither the differences between the means or variances were statistically significant for any of these groups. Differences between the sexes for the two groups were also nonsignificant.

Validity

I. G. Sarason (1961) found the Taylor Manifest Anxiety Scale to correlate with his Test Anxiety Scale .46 for college men and .53 for college women. The Taylor Scale correlates .44 with the AACL (Winter et al., 1963), and .66 with the S-R Inventory of Anxiousness using the total score with the test anxiety plus ten other experiences (Endler et al., 1962). There was no significant correlation with the Palmar-Sweat Index (PSI) (Endler, et al., 1962 & Winter et al., 1963).

Concluding Remarks

Paper-and-pencil measures of anxiety are:

1. easily administered,
2. can be presented to an entire group or to an individual,
3. are objective, and are therefore easily scored.

In spite of these important assets of the scales, there are some serious reservations concerning their validity.

Aiken, Jr. (1962) pointed out that one problem with anxiety scales is the numerous definitions of anxiety offered. According to Getzels and Jackson's (1963, pp. 574-576) theory, measurements developed around one definition may be contradictory to measurements developed around a different definition. The measures in the present study were chosen because of their rationale for the development and the method of construction. Another problem with anxiety scales is the possibility of conscious or unconscious faking.

S. B. Sarason and Mandler (1952) realized the weaknesses in using anxiety questionnaires to assess anxiety, pointing out that two individuals might have the same degree of anxiety but differ in their readiness, conscious or unconscious, to reveal it.

I.G. Sarason (1960) considered convenience to be probably the major reason for the wide use of paper-and-pencil indices of anxiety and that, "while convenience is a desirable characteristic, research is needed to investigate less convenient but perhaps more useful indices." In summing up his position, he stated, "Perhaps the most parsimonious statement that one can make concerning what is measured by existing scales of anxiety is that they measure the extent to which an individual is willing to admit to experiencing anxiety in certain situations." Perhaps physiological measures are the less convenient but more useful indices.

Physiological Measures of Anxiety

Physiological measures of anxiety, unlike psychological measures already discussed, are not dependent on the process of externalized introspection. According to Jost (1953) the physical changes due to anxiety in a human being take place before any verbal response. However, though physiological measures are relatively objective and free from faking (conscious or unconscious), it cannot be said that a physiological response to a given anxiety stimulus is an absolute measure of anxiety. Clearly, there are several factors besides anxiety which manifest themselves in the form of physical responses. Among these factors are: environmental temperature, muscular exercise, digestion, fever, general level of excitement, sleep, time of day, and seasons (Best & Taylor, 1961, pp. 274-276, 302, 884, 1270; Mac Bryde, 1944, p. 1367; & Wenger, 1943).

Luria (1932, pp. 46-76), was among the first to study physiological responses in connection with test-taking anxiety. He "applied the method of associated motor reactions, by giving the subject speech stimuli, and recording the speech responses connected with simultaneous motor pressures." The reactions to thirty word-stimuli were taken for each subject by means of a dynamoscope. Of the thirty words, eight were considered as critical (pertaining directly to the testing situation), nine were doubtful, and thirteen were indifferent.

One study (Luria, 1932, pp. 46-76) was concerned with the "cleansing" or "purgation" that was required at the university. Each student was called in before a special commission that reviewed the student's academic record, his social-political inclinations, his academic activity, and then made its decision. An unfavorable judgment meant the student was expelled from the university and, as a result, all his work and future plans came to naught. Luria considered this experience more traumatic than a regular school examination. Thirty students, nineteen women and eleven men, were taken directly from the line awaiting the stressful event and tested. Part of the group were also tested again after the examination. Luria found that the average reactive time depended upon the character of the stimulus used. Approximately thirty per cent more time was required to respond to the critical stimuli than was required in the case of the indifferent stimuli. The presentation of the stimuli directly connected with the traumatic event usually produced an obstruction of the associative processes and a marked disturbance of the motor reactions. He was led to believe that the affective influence of the situation was more closely connected with the situation of expecting the trauma than with the trauma itself.

Another study he pursued was concerned with an ordinary school examination. The results of the ordinary examination were similar to those of the "cleansing." Even though the examination was less traumatic, the psychological structure of both were analogous. The average reaction time for the "cleansing" was 2.29, whereas for the examination, it was 2.2. Normally the time does not exceed 1.5-1.7. He also found, "a great disturbance of the accompanying motor reactions corresponding to the marked delay of the associative process." The movements indicated that the delays were not connected with the simple lowering of the energetic tones of behavior as would occur in fatigue or in drowsiness, but they were the result of a diffuse excitation, which broke the normal associative process.

Not all students showed the same responses. Approximately thirty per cent of the subjects presented a picture of intense reactive lability whereas twenty-five per cent showed reactive stability. Luria's first supposition was that some feared the examination while others, feeling secure and well prepared, did not, and thus were stable. Controlled experiments did not show this to be true. The symptoms obtained in both cases were almost identical in the well-prepared as well as in the incompetent students. He felt that the degree of fitness apparently did not play a role with the affective reactions. The problem he uncovered in the 1920's is a problem still being investigated today.

He divided his students into two groups: one, those who became quite excited before an examination and showed neurotic symptoms, and the other, those who did not become excited before an examination and did not show neurotic symptoms. His belief was that a large proportion of students who become excited before an examination were high in neurotic tendency and a large proportion of those who did not become excited were low in neurotic tendency.

Brown (1938b) tested this theory by correlating scores on a questionnaire (Brown, 1938a) designed to measure test anxiety, with those on Willoughby's Clark Revision of the Thurston Personality Schedule. He found a moderate relationship between neurotic tendency and emotional reactions in students before examinations, but he considered the correlation to be far too low to warrant regarding examination neurosis as merely a special case of general neurotic tendency. He pointed out a few reasons why he thought one student more than another might become excited before examinations: (a) grades may be stressed more in his home, (b) he may need high grades to get into the professional school he wishes to enter, (c) or his older brothers may be better students than he.

He also correlated the scores on the questionnaire with changes in physiological measures (Brown & Van Gelder, 1938) and found no correlation between them. Despite the lack of relationship between the two types of measures, he did not consider that this invalidated either the questionnaire or the physiological measures. He pointed out that the questionnaire was concerned with examinations in general, whereas the physiological measures were taken before a specific examination. Landis, Gullette, and Jacobsen (1925) also failed to find any marked correlation between questionnaire and physiological measures of emotion.

In order to determine the relationship between scores on the questionnaire and achievement, Brown and Van Gelder used partial correlation with intelligence held constant. The obtained correlation was -.19 ± .05. He considered the correlation to be low but highly suggestive of lower examination grades in general for those who become excited before an examination. This is in direct contrast to Cannon's (1915, p. 311) emergency theory. Brown points up the fact that, according to Cannon, students who are emotionally excited before an examination should perform better than those who are calm before an examination, other things being equal.

Lacey, Bateman, and VanLehn (1953) recorded multiple physiological measures on eighty-five male college students under four conditions of stress in an investigation of response specificity. Though this particular investigation did not involve an actual examination, two of the four stress stimuli imposed on the subjects (mental arithmetic and letter association) did require mental activity closely akin to that required by the usual achievement or aptitude-measuring examination. Palmar conductance, heart beat rate, and heart beat rate variability were measured while the subject underwent hyperventilation, the cold pressor test, and the previously mentioned mental activities. The study supported the principle of relative response specificity to the extent that, for given autonomic functions, there existed quantitative variation among individuals in the degree to which a response pattern was stereotyped.

In 1961 Wenger, Clemens, Coleman, Cullen, and Engel, using autonomic variables,retested autonomic response specificity on male college students. Among the physiological measures used were: electrical skin resistance, heart beat rate, respiration rate, finger and face temperatures, and systolic and diastolic blood pressure. These measures were taken while the subjects underwent hyperventilation, the cold pressor test, letter association tasks, and mental arithmetic tasks. This study supported the conclusion arrived at in the previously mentioned investigation conducted by Lacey and his colleagues.

Ax (1953) and Schachter (1957) have shown that the sympathetic nervous system is extensively involved during anxiety. According to Brown and Van Gelder (1938), it is "common knowledge" that examinations "increase the excitement of students," and that the degree of increase varies directly with the severity and importance of the examination. If, then, examinations do increase anxiety, the responses of the sympathetic nervous system during test performance should serve to indicate levels of anxiety.

In the present investigation, five physiological measures were recorded. A brief review of the literature for each measure follows.

Respiration

In 1929, Cannon (p. 211) found that animals experiencing pain and emotional excitement show deep and rapid respiration. Seven years later, Freud (1936, p. 91) considered the respiratory organs, along with the heart, to be the most common and the most definite physiological indicators of anxiety.

Though neither Cannon nor Freud assessed anxiety induced by an examination-taking situation, Brown and Van Gelder (1938) found similar results in studies of anxiety produced by examinations of varying degrees of difficulty. They found a statistically significant increase in the subjects' respiratory rates before taking the difficult examinations.

Clemens (1957) investigated the responses of the autonomic nervous system under the influence of epinephrine injections. If, during anxiety, there is an increased flow of epinephrine, it seemed probable that, with other factors held constant, the responses during anxiety would be in the same direction as those under the influence of injected epinephrine. Clemens discovered that the subjects' responses to the injection was an initial decrease in respiration rate followed by an increase in respiration rate during later time intervals.

Rogers (1961, p. 346), whose findings agree with those of Clemen claimed that sympathetic stimulation dilates the bronchi. Fulton (1955, pp. 238, 239) held that when the organism is called upon to cope with a sudden emergency, the sympathetic nervous system causes a secretion of great quantities of epinephrine. If this greater quantity of epinephrine results in a dilation of the bronchi, surely respiration, or at least the amount of oxygen intake would be influenced.

Heart Beat Rate

Wenger et al. (1961) observed a slightly higher heart beat rate (66 beats per minute) when subjects performed mental arithmetic tasks than when making letter associations (64 beats per minute). Lewinsohn (1956) found his subjects' heart beat rates increased from a mean base level of 88.10 beats per minute to a mean stress level of 93.5 beats per minute while taking a modified form of the Digit Symbol test under failure stress conditions.

Increased heart beat rate was also observed by Brown and Van Gelder (1938) in subjects just before taking a senior comprehensive examination in psychology at the University of Chicago (a mean increase of 22.77 beats per minute above normal). After the examination, the subjects' mean heart beat rate showed only a 5.43 beats per minute increase above normal. The same measures were taken on a group of second year medical students prior to taking a relatively less important quarterly pharmacology examination. In this case the mean pulse rate rose to only 8.13 beats per minute above normal.

Chambers (1962) recorded the pulse rates of a group of medical students taking a sectional examination in pharmacology. The mean increase of 6.4 beats per minute was similar to that of 8.13 found by Brown and Van Gelder in a similar situation.

Smith and Wenger (1965) recorded heart beat rates for eleven doctoral students just before a preliminary oral Ph.D. examination. Their findings confirmed those of Brown and Van Gelder (1938) and Chambers (1962). They recorded a mean heart period of 116.65 mmin/10N (85.7 heart beats per minute) for the examination group in contrast to a mean heart period of 145.90 mmin/10N (68.5 heart beats) for the control group.

Harleston, Smith, and Arey (1965) investigated anxiety measured by heart beat rate. They found no significant difference between low, medium, and high anxious individuals while solving anagrams.

Galvanic Skin Response (GSR) and Other Epidermal Measures

One of the most popular measures of autonomic activity associated with affective and emotional states as evaluated by Stevens (1951, pp. 474, 475) is the galvanic skin response (GSR). He states that, "the GSR, perhaps more than any other indicator of bodily change (with the possible exceptions of blood pressure and heart beat rate), is a sensitive index of cortical and higher-level mental functions."

According to Stevens and others the nerve supply of the sweat glands is exclusively sympathetic, but the neurohumoral agent at the effector is acetylcholine rather than the usual adrenergic substance. The resistance of the skin involved in the GSR is believed to be due to a polarization-capacity effect that varies as a result of the sweat gland activity.

Silverman and Powell (1944, p. 300) explained that, "Emotional, intellectual and sensory stimuli will cause a type of sweating involving palms, soles and axillae." They state further that, "normally emotional sweating is commonly seen in states of anticipation and has sometimes been referred to as anticipatory sweating. A student before an examination . . . will show sweating, particularly of the palms."

Darrow (1936) considered palmar galvanic skin reflex and blood pressure to be preparatory and facilitative reactions and ones that are especially valuable as indicators at the more moderate levels of "adaptive mobilization." In sleep, he pointed out, the resistance tends to be high and the conductance (the reciprocal of skin resistance) low. Stevens (1951) also explains that ". . . the resistance level frequently increases steadily as a subject relaxes, and rises to still higher levels during sleep." He considers this to be a disadvantage of the resistance measures, for, if two responses of the same magnitude are superimposed on different resistance levels, they will not be recorded as equal. For this reason some type of resistance change should be employed.

Test anxiety and skin conductance were investigated by Kissell and Littig (1962) in an introductory psychology class at the University of Buffalo. They measured palmar skin conductance while the subject worked on a modified form of Feather's perceptual reasoning task. High test anxiety was more associated with high skin conductance (reciprocal of resistance) under conditions of failure than were low test anxiety scores ($p < .01$).

Clemens (1957) gave subcutaneous injections of USP epinephrine (0.3 cc in 1/1000 saline) to 45 male subjects and observed an increase in skin conductance.

In a study conducted by Smith and Wegner (1965) palmar skin conductance was recorded for doctoral students just prior to their preliminary oral examinations. The mean palmar conductance just prior to the oral examination was higher, but not significantly higher, than were the readings for the comparison test.

Berry and Martin (1957) attempted to determine a relationship between GSR, the kind of instructions presented to the students, and Sarason's test anxiety scale. The subjects were presented with one of three types of instructions: apprehension arousal, neutral, or reassurance followed by an identical treatment in a conditioning situation. The findings supported the hypothesis that instructions affected the extent of GSR conditioning. There was a significant difference in the reactions of the sexes caused by instruction interaction. For the males, reassuring instructions resulted in lessened conditionability whereas the opposite was true for the females. The Sarason test anxiety scale was not significantly related to GSR conditioning. The following investigation used GSR and test anxiety and found a relationship.

Winter, Ferreira, and Ransom (1963) investigated the relationship between the Palmar-Sweat Index (PSI) and the Affect Adjective Check List (AACL) under six experimental conditions, two of which were classroom examinations. Two weeks after the last experimental session, the Taylor's Manifest Anxiety Scale (MAS) was administered. The combined AACL scores for all six conditions related significantly with their scores on the MAS ($r = .44 \quad p < .05$). The PSI was not significantly related to either the AACL or the

MAS. This low correlation of a physiological measure with pencil and paper-test of anxiety is a usual finding.

Blood Pressure

Darrow (1936) considered blood pressure, along with the GSR, to be probably the best indicator of the facilitative, preparatory, or emergency functions that are mediated predominantly by the sympathetic nervous system.

According to Best and Taylor (1961, pp. 274-275), excitement, fear, worry, and the like affect markedly the arterial blood pressure, especially the systolic. They report that the systolic blood pressure for boys about age 17 reaches 120 mm. Hg. The systolic blood pressure for girls of the same age is approximately 4 or 5 mm. lower. The average diastolic blood pressure of an adult young male at mental and physical rest and in a sitting position is 80, and the average pulse pressure is 40. However, the normal range of blood pressures may be from 90 to 120 mm. for systolic and from 60 to 80 mm. for diastolic blood pressure (Best and Taylor, 1961, p. 274).

A sex difference in blood pressure responding was observed by Milliken (1964, pp. 309-311). He investigated blood pressure change as it related to increased problem difficulty in mathematical and verbal areas. The male subjects who had high test scores on both the mathematical and verbal sections had the smallest increase in blood pressure. The female subjects who scored high on both sections had the greatest increase in blood pressure. Milliken found that both sexes increased in anxiety under stress to the extent that they exhibited a mathematical deficit. However, the males who scored high on the mathematical section but low on the verbal section reacted with greater physiological changes during the mathematical testing than during the verbal testing. The female subjects of this group were only slightly more anxious, as measured by blood pressure, during the mathematical testing than during the verbal sections.

Rather than studying blood pressure change with difficult and easy sections of an examination as Milliken did, Brown and Van Gelder (1938, pp. 1-9) studied blood pressure changes as related to difficult and easy examinations. The change in the mean systolic blood pressure before a final comprehensive examination was 15.11 as compared to 3.60 before a quarterly examination. The diastolic blood pressure change was in the same direction as the systolic, but the change was less. Before the comprehensive, the diastolic change was 4.00 compared with -0.50 before the quarterly examination.

Milliken and Spilka (1962) also found higher blood pressure during performance on a difficult mental task than during performance on an easy task.

A comparison was made by Smith and Wenger (1965) of the blood pressure readings recorded on students before taking an oral doctoral examination. The mean systolic blood pressure before the examination was 126.05 compared with 116.23 for the comparison reading. The mean diastolic pressure was 80.09 for the examination reading and 76.14 for the comparison reading. The differences for the two readings were significant at the .01 level for both the systolic and the diastolic blood pressures.

Wenger et al. (1961) observed blood pressure for thirty-six male university students. He found a higher systolic blood pressure and pulse pressure when the subject was performing letter association tasks than when performing tasks requiring mental arithmetic. The reverse was true of diastolic blood pressure. The systolic blood pressure was 133 for letter association and 111 for mental arithmetic. The pulse pressure was 70 for the letter association and 32 for mental arithmetic. The diastolic blood pressure was 63 for letter association and 72 for mental arithmetic.

From the studies just cited it would appear that the systolic blood pressure would be more likely to rise during mental stress than diastolic blood pressure.

Temperature

Stevens (1951, p. 477) suggested skin temperature as an indicator of emotion. Wynn, in 1919, reported a study that tends to confirm Stevens' position. Wynn (1919) discovered an elevation of temperature in draftees at the time of their physical examination. The average temperature of the 324 men observed was 99.3° F. In a second study in which he recorded the temperatures of nursing applicants taking a registration examination, Wynn found a .60° F. elevation in temperature before the examination for two-thirds of the group, and a .5° F. depression in temperature for three-fifths of the group after the test.

Lucio and Wenger (1961, pp. 35-61) recorded twelve measures on student teachers and found finger temperature to show a significant positive relationship with teaching performance.

An investigation by Wenger, Clemens, Colemen, Cullen, and Engel (1961) resulted in higher face temperatures than finger temperatures and both were higher for letter association tasks than for mental arithmetic. Their readings for finger temperature were 29.7 and 31.2 for mental arithmetic and letter association respectively, while the face temperatures were 32.2 and 32.6 respectively. As can be noted these differences are only slight.

Ax (1953) recorded physiological measures during fear and anxiety for 43 subjects. He found increases in face temperatures to be greater during fear than during anger, and decreases in finger temperature to be less during fear than during anger. Schachter (1957) showed the drop in face temperature during anger to be less in hypertensives than in normotensives.

Since the emotional experience of an examination may be anxiety, fear, or even anger, or, indeed, a combination of any two or all three of these, the above studies indicate that a subject's face and finger temperatures would depend not only upon the degree of emotion experienced but also upon the type of emotion experienced to the greatest degree.

In a study conducted by Chambers (1962) medical students were found to experience a mean oral temperature increase of 1.26° F. while taking a pharmacology examination. This increase was measured as the difference between the mean examination readings and the mean control readings taken approximately the same time of day during a week when the subjects were not taking examinations.

Clemens (1957) found an increase in forehead temperature, and decreases in finger and hand temperatures of subjects just previously injected subcutaneously with USP epinephrine (0.3 cc in 1/1000 saline).

Stevens (1951, p. 477) says, emotional stress is reported to produce a fall in skin temperature. "Conflict is associated with vasoconstriction and a fall in temperature, whereas uninhibited action and emotional security are said to result in vasodilatation and a rising skin temperature."

Best and Taylor (1961, p. 884) present some interesting figures on body temperature. The oral temperature for a large sampling of normal subjects ranged from 96.6° F. to 100.0° F. with a mean reading of 98.4° F. Intraindividual and interindividual variations in temperature occur according to the time of day. A person's temperature may be two or three degrees Fahrenheit higher in the late afternoon or evening, when body temperature is customarily at its maximum, than during the hours between three and five in the morning when it is usually at its minimum.

Cannon (1932, p. 177) gives slightly different figures for this 24 hour temperature variation cycle. He reported a variation span of 1.8° F., setting the maximum about 4:00 P.M. and the minimum about 4:00 A.M. Because of this fluctuation of body temperature, it is important that research plans take into account the time of day the subjects' temperatures are recorded.

Summary

Theories of Anxiety

Anxiety has been studied by Freud, Rank, Horney, May, Mowrer, James, Goldstein, and many others. It has been approached from many points of view: e.g., the analytical, physiological, psychological, philosophical, to mention a few.

Anxiety is one of the most perplexing problems of our day. Its consequences touch individuals in every walk of life. There are almost as many theories of anxiety as there are individuals who have studied it. One view, held by many, is that it is the anticipation of danger (Freud, 1936, pp. 149-150).

In general, the term fear refers to reactions to known, tangible and objective dangers, while the term anxiety refers to reactions to unknown, intangible and subjective ones (Marmor, 1962). According to Horney (1939, pp. 194, 195), the same situation may elicit fear or anxiety. If the person is afraid, but does something about the situation, the feeling is called fear. But if he is afraid and helpless to do anything about it, the experienced emotion is called anxiety.

Although anxiety may have a destructive power, it can also have a constructive force (Mowrer, 1950, p. 545; Marmor, 1962; May, 1950, pp. 206-208; Janis, 1958, pp. 395-412). Anxiety has been considered by many to be a learned concept (Martin, 1961; May, 1950, p. 208; Mowrer, 1950, p. 65) with a drive property (May, 1950, pp. 138-140; Mowrer, 1950, pp. 65, 66; Coleman, 1964, p. 75; Spence, 1956, p. 165; Mandler and Sarason, 1952).

As evidenced by the diverse and contradictory theories and ramifications of leading psychologists, anxiety and its consequences are far from being understood.

Measure of Task Performance

The Cooperative Academic Ability Test form "A" published by the Educational Testing Service was used as the measure of performance. The Kuder-Richardson Formula 20 reliabilities were .88 for the verbal, .92 for the mathematical, and .94 for the total score (the total 100 items) for the twelfth grade. Correlations between the Academic Ability Test and the Scholastic Aptitude Test were found to be .83 for the verbal score, and .86 for the mathematical score.

Measure of Proficiency

The measure for proficiency was the ITED published by the Science Research Associates (1962). It was designed to measure broad intellectual skills, understanding, and ability to apply learned materials, rather than recall specific facts. Validity coefficients with college grades range between .50 and .60.

Psychological Measure of Anxiety

Four psychological measures of anxiety were used.

S-R Inventory of Anxiousness (S-RI). The S-RI, developed by Endler, Hunt, and Rosenstein (1962), employs fourteen responses quantified on a five-step scale ranging from *none* to *very much*. The scale is designed to measure responses associated with many experiences, one of which is the examination situation.

The Coefficient Alpha reliability was .87 when a final examination was used as the stimulus.

The S-RI correlates .46 with the Taylor Manifest Anxiety Scale, .66 with the Mandler and Sarason Test Anxiety Quotient (TAQ), and -.06 with the Palmer-Sweat Index (PSI).

Affect Adjective Check List (AACL). The AACL, developed by Zuckerman (1960), is a list of 61 adjectives with affective connotations to be checked either the way the individual feels at present (the "today" scale) or the way the individual usually feels under the indicated circumstances (the "general" scale).

The reliability for the "today" scale was .85 by the Kuder-Richardson Formula 20 and .30 for retest reliability.

The AACL correlated .40 ($p < .05$) with the MAS for the first examination day and .28 (nonsignificant) for a mean of three examination days.

Test Anxiety Scale (TAS). The TAS, developed by I. G. Sarason (1958) was designed to measure the anxiety associated with test-taking experiences. It is composed of sixteen true or false statements.

The TAS correlated .45 ($p < .05$) with the MAS for male college students and .53 ($p < .01$) for female college students.

Taylor's Manifest Anxiety Scale (MAS). The MAS was developed by Janet Taylor (Spence) (1953) and shortened by Bendig (1956). It was designed to measure the general anxiety experienced.

The reliability for the short form was .75 by the Kuder-Richardson Formula 21.

The MAS correlated .46 ($p < .05$) with the S-RI, .40 ($p < .05$) with the AACL, .45 ($p < .05$) for males and .53 ($p < .01$) for females with the TAS.

Physiological Measures of Anxiety

Ten physiological measures of anxiety were used.

Respiration. According to Cannon (1929, p. 211), animals experiencing pain and emotional excitement show deep and rapid respiration. Increased respiration rate before an examination was observed by Brown and Van Gelder (1938). Clemens (1957) found injected epinephrine to produce an initial decrease in respiration rate followed by an increase in respiration rate during later time intervals.

Heart Beat Rate. An increase in heart beat rate associated with mental activity was observed by Wenger et al. (1961), Lewinsohn (1956), Brown and Van Gelder (1938), Chambers (1962), and Smith and Wenger (1965).

Galvanic Skin Response and Other Epidermal Measures. Stevens (1951, pp. 474, 475) considers GSR to be one of the most popular measures of autonomic activity associated with affective and emotional states.

High test anxiety scores were more related to skin conductance (the reciprocal of resistance) under conditions of failure than were low test anxiety scores (Kissel & Littig, 1962).

Smith and Wenger (1965) found the mean palmar skin conductance for 11 doctoral students to be higher just prior to an oral Ph.D. examination, but not significantly higher, than the readings a month before or a month after the examination.

Winter et al. investigated the PSI for 19 undergraduate students and found no significant relationship between the PSI and the MAS or the AACL.

Blood Pressure. Darrow (1936) considered blood pressure, along with the GSR to be probably the best indicator of facilitative, preparatory, or emergency functions that are mediated predominantly by the sympathetic nervous system. Excitement, fear, worry, and the like affect markedly the arterial blood pressure, especially the systolic (Best and Taylor, 1961, pp. 274-275). They report the average adult male to have a systolic blood pressure of 9 to 120 mm. Hg and diastolic blood pressure to be 60 to 80 mm. Hg. The average young adult female's blood pressure is approximately 4 or 5 mm. lower than that of the males. The average pulse pressure is 40.

Brown and Van Gelder (1938, pp. 1-9) found a greater change in blood pressure prior to an important examination than prior to a less important examination. A higher blood pressure was also evidenced during performance on a difficult mental task than during performance on an easy task (Milliken & Spilka, 1962). The systolic and diastolic blood pressures were significantly higher before a Ph.D. oral examination than they were for the comparison readings.

Wenger et al. (1961) found higher systolic blood pressure and higher pulse pressure when subjects were performing letter association tasks than when performing mental arithmetic. The reverse was true for diastolic blood pressure. The direction of systolic blood pressure seems to be better predicted than that of the diastolic blood pressure or pulse pressure.

Temperature. Stevens (1951, p. 477) suggests skin temperature as an indicator of emotion. Wenger et al. (1961) found the face temperature to be higher than the finger temperature for letter association tasks and for mental arithmetic tasks.

Clemens (1957) found an increase in forehead temperature, and a decrease in finger and hand temperature for subjects who had just previously been injected subcutaneously with U.S.P. epinephrine (0.3 cc in 1/1000 saline). Wynn (1919) and Chambers (1962) observed a higher oral temperature associated with an examination.

Stevens (1951, p. 477) reported emotional stess to produce a fall in skin temperature.

CHAPTER III

ANXIETY AND ITS RELATIONSHIP TO OTHER VARIABLES

The plan of the present chapter was to present a brief review of the literature concerning the relationship of anxiety to performance.

Anxiety and Performance on an Ability Test

An important aspect of the study of anxiety was to determine its relationship to performance on an ability test. Manifest anxiety scales and the test anxiety scales have both been investigated. During the last few years the literature has been prolific with studies concerned with paper-and-pencil measures of anxiety and their relation to intellectual performance.

Calvin, McGuigan, Tyrrell, and Soyars (1956) investigated the relationship between the Taylor Manifest Anxiety Scale (MAS) and scores on the higher form of the Otis intelligence test. With a group of 54 female undergraduate students, they found no significant relationship between the MAS and the

Otis (r = -.02).

Dana (1957) also found a nonsignificant correlation between the MAS and the Wechsler-Bellevue Form I intelligence test. This finding was true when 100 normals and 100 neurotics, similar in intelligence and education, were tested.

Faber and Spence (1955, p. 10), who have made an extensive study of anxiety, state that they have "been unable, over a period of years, to find any relation between the A-scale scores of college students and conventional measures of intellectual ability, such as entrance-examination scores and grade-point averages." These studies made use of the Taylor MAS.

Erickson (1963, p. 43), as a result of a review of the literature, found the mean score of the childrens' manifest anxiety scale (CMAS) to vary for different geographical locations. His means ranged from a low of 12.87 to a high of 23.29. If there are differences this large with the CMAS perhaps similar differences prevail with the manifest anxiety scale. This factor should be considered in making comparisons between studies in various geographical areas.

I. G. Sarason (1960) points out that for college students, it appears, that tests of the American Council on Education (ACE) type are unrelated or only slightly related to, measures of general anxiety such as the MAS.

I. G. Sarason (1957) was surprised to find the most reliable studies in the literature to show anxiety to have no demonstrable relationship to academic performance. The scales that had been used were those designed to measure anxiety in general. It seemed to him that these scales ignored an important observation. People are not anxious all the time, and often, one can specify the conditions that will lead to increased anxiety. Therefore, he felt, a measure designed to assess the anxiety under the specific conditions that aroused the anxiety would be more meaningful. In his investigation he computed the correlation of the Scholastic Aptitude Test (SAT) scores with test anxiety and with general anxiety. In addition he determined the relationship between the Mathematical Aptitude Test (MAT) scores and the two anxiety scales just mentioned. The test anxiety was shown to be significantly related to performance on both tests with the correlation of -.14 ($p < .05$) for the SAT and -.20 ($p < .01$) for the MAT. The more anxious the subject, the lower his performance tended to be; and the less anxious, the higher was his performance. General anxiety was not significantly related to performance on either test.

In another study, Sarason (1961) found significant and negative correlations between test anxiety and six college entrance scores in a study with college students. However, general anxiety did not relate significantly with any of the six entrance scores. Sarason interpreted the results as supporting the hypothesis that an anxiety scale designed to measure anxiety in a specific situation, like a test situation, is more predictive of the anxiety elicited in that situation than a scale developed to measure general anxiety.

In a study with four grade levels, S. B. Sarason, et al. (1960, pp. 125-135) showed the Test Anxiety Scale for Children (TASC) to be more related to intelligence test scores than the General Anxiety Scale for Children (GASC).

I. G. Sarason (1959) found a negative correlation between test anxiety and the 1948 ACE L scores. However, this relationship was only significant for the women (-.36 $p < .01$). The correlation for the men, even though in the same direction, did not reach significance.

A positive correlation of +.21 ($p < .05$) was found between scores on the Henmon-Nelson Test of

Mental Ability (college level) and scores on the anxiety questionnaire in a study by S. B. Sarason and Mandler (1952).

Grooms and Endler (1960) attempted to do a partial replication of S. B. Sarasons and Mandler's (1952) study. They trichotomized a group of 91 male college students at the Pennsylvania State University as to high, medium, or low test-anxious groups according to their scores on the Mandler and Sarason Test Anxiety Questionnaire. The results were a significant *negative* correlation between test anxiety and the aptitude scores as compared with the *positive* correlation ($r = +21$, $p < .05$).

S. B. Sarason, Davidson, Lighthall, Waite, and Ruebush (1960, pp. 136-147) also found a significant positive correlation between the TASC and Primary Mental Abilities (PMA). The results showed an overall correlation of .24 ($p < .001$), with test anxiety being more closely related to the test-like tasks (word grouping test of reasoning, number) than to the non-test-like tasks (perception, spatial).

Silverstein (1961) reanalyzed the data by S. B. Sarason, et al. (1960, pp. 136-147) in order to determine how factors of test-likeness, reading requirement, and cultural familiarity of the PMA relate to test anxiety. He showed that in combination, the three factors were highly related to the effects of anxiety, while in isolation only the test-likeness and cultural familiarity factors related to the effects of test anxiety. Reading requirement appeared to be related only through its relation to cultural familiarity. The results of the investigation suggest that the influence of anxiety differs depending upon the characteristics of the task of the test.

Anxiety and Achievement

According to Ruebush (1963, p. 498, 499), many studies have found a negative relationship between anxiety and achievement test scores. However, there are some investigators who have reported either a positive relationship or none at all.

In an investigation of the grade point averages (GPA) of 305 students at Yale University, I. G. Sarason (1957) found a significant negative correlation between test anxiety and GPA for the first two years. The GPA's for the same group in their junior and senior years did not correlate significantly with the subject's anxiety scores.

At the same time, the subject's general anxiety (GAS) showed a positive relationship with GPA, significant at the .01 level for the first two years and at the .05 level for the fourth year. The correlation for the third year was not statistically significant.

Suinn (1965) failed to replicate the significant negative correlation between test anxiety and grades that was found by I. G. Sarason (1957). Suinn's subjects were 55 students at a highly selective private college in Washington State and 70 students in a California state college. All students in both samples were freshman psychology students. Suinn attempted to explain a possible cause for the failure to replicate by pointing out that his subjects were freshman and a great majority of Sarason's subjects at the time of taking the questionnaire were sophomores and juniors. Perhaps, he suggested, test anxiety has a more detrimental influence upon academic performance for some grade levels than for others. Even Sarason's study bears this fact out. When the scores on the anxiety scale were correlated with GPA's of the students in their junior and senior years, Sarason's correlations failed to reach significance also. I. G. Sarason (1957) found a positive correlation between general anxiety (GA) and GAP. Suinn did replicate these findings of a positive correlation for his first sample, private college students, but not for his second sample, state college students.

Experimental Studies With Psychological Measures of Anxiety

Studies involving paper-and-pencil tests of anxiety are numerous in the literature. Only a sampling of studies will be mentioned. The measures discussed will not be restricted to the instruments used in this investigation, because valuable information has been reported involving other measures as well.

Investigators have sought an interpretation of the correlation between anxiety and intelligence. Sarason and Palola (1960) hypothesize that the performance of low and high-anxious subjects varies according to type of instruction and task difficulty. They manipulated simultaneously the variables of anxiety, difficulty of task, and instructions (motivational and neutral). The tasks used in this study were a digit-symbol test and an arithmetic test. The analysis of variance showed significant triple interactions involving the three variables in every case. In general, high difficulty of task and highly motivating instructions combined to lower the performance of high-anxious subjects. The low-anxious group performed better than the high-anxious group with the difficult task and high anxiety instructions. The high-anxious subjects performed better than the low-anxious subjects with the difficult task and neutral instruction and also on the easy task with both high anxiety and neutral instructions. However, the difference between the means for the easy form did not reach significance. As can be seen from these results, the high-anxious subjects performed better than the low-anxious subjects under every condition except the difficult task and high anxious instructions. The fact that they performed better with the low-anxiety instructions on difficult material would probably indicate that their performance was not dependent upon extrinsic motivation. On the other hand, the low-anxious subjects only performed well when external stimulation was applied.

For many individuals an IQ test is an anxiety-producing stimulus. The test situation, involving both anxiety and difficult material, would probably result in impaired performance of the high anxious individuals. Since test anxiety is usually more negatively correlated with IQ scores than with achievement or course grades, these individuals would probably show performance superior to that anticipated by their IQ scores. Consequently, they would be labeled by psychologists and educators as over achievers when in reality their true potential might be above many of their higher scoring peers. Accordingly, individuals of this type may be disqualified for gifted classes or scholarships.

Allison (1964) manipulated five experimental conditions to determine the effect of anxiety on intelligence test performance for sixth grade boys and girls. The results revealed no significant difference in performance for anxiety levels, experimental conditions, sex or any of the interactions. Allison concluded that the high and low stress conditions gave no evidence of affecting group intelligence test performance of elementary school children.

At the University of Colorado, Smith (1964), investigated the results of induced stress in college students just prior to taking a regular course examination. Irrespective of sex differences, the high anxious subjects under the stress conditions performed significantly poorer on the academic examination than their low anxious classmates.

Paul and Eriksen (1964) also investigated the effects of test anxiety on "real-life" examinations with college students under anxious and non-anxious conditions. The results showed significant negative correlations between the TAQ and SCAT scores as well as between the TAQ and scores on the regular course examination. However, there was no significant correlation between the TAQ and performance on the parallel form administered under anxiety-reducing conditions. For the sample as a whole, there was no significant relationship between the TAQ and the differential performance on the anxious and non-anxious examination.

Mandler and S. B. Sarason (1952) attempted to investigate the role of drive states in a testing situation by using success, failure, and neutral reports with students in an introductory psychology course. The success or failure report elicited improved performance for the low-anxious group but depressed performance for the high anxious group. From the results of the investigation, optimal conditions for the high anxiety group were neutral instructions, optimal condition for the low anxiety group was the failure report.

I. G. Sarason and Minard (1962) attempted to determine the effect of test anxiety on the performance of college students on an individually administered short form of the Wechsler Adult Intelligence Test. Half of the subjects received achievement-orienting instructions, and half received neutral instructions. Under the achievement-orienting instructions on the comprehension section the low test anxious subjects performed better than the high test anxious ($p < .02$) whereas, with neutral instructions, there was no significant difference.

Sex Difference

In the previously mentioned investigation (Smith, 1964) involving stress and nonstress in high and low-anxious students taking a regular course examination in psychology, the high anxious male subjects' performance was significantly jeopardized by the induced stress, whereas the performance of the females was unaffected by high anxiety or stress.

Even though S. B. Sarason, Davidson, Lighthall, Waite and Ruebush (1960, pp. 136-146, 250) found a consistent and marked sex difference in the scores on the Test Anxiety Scale for Children, they found no tendency for the scores of the boys to be more closely related to the Primary Mental Ability test scores than were those of the girls.

Waite, Sarason, S.B., Lighthall, and Davidson (1958) studied children from grades two through five and matched groups of low scores and high scores on the Test Anxiety Scale for Children with respect to grade, sex, and intelligence. These two groups were presented with a learning task. The low anxious group performed better than the high anxious group. The differences between the anxiety groups held up better with the boys than with the girls. In general, the girls appeared to perform better than the boys.

Information that Sarason, S.B., et al. (1960, pp. 250-251) obtained from parent interviews revealed that high-anxious boys had significantly more illnesses than did the low-anxious boys. He also discovered that girls had fewer illnesses than the boys and that there was no difference between the high and low-anxious girls in this respect.

Sarason, S. B., et al. (1960, p. 239), reported that girls obtain higher scores than boys on both the Test Anxiety Scale for Children (TASC) and the General Anxiety Scale for Children (GASC), the difference between the boys and girls being greater on the GASC than on the TASC.

Ruebush (1960) and S. B. Sarason (1958) reported high test anxious girls to present a more favorable impression than low test anxious girls. There was also evidence that the emotional behavior of girls may be influenced more by variations in teacher behavior than that of boys. (Davidson & Sarason, S.B., 1961).

Ruebush (1963, pp. 484, 486, 500) as a result of a study of the literature reported some interesting findings. He found evidence for the relationship between anxiety and dependency to be greater for boys than for girls. Anxiety in boys seemed to be related to behavioral indications of dependency toward teachers, social inadequacy, insecurity in play, and immature game preference. The same emotional maladjustment observed in anxious boys was not true of the anxious girls.

The high test-anxious girls presented a more favorable impression than the low test-anxious girls. The high-test anxious girls more than the boys demonstrated a greater need-achievement in the classroom and were more forceful and outgoing in their verbalizations. There is some reason to believe that sex differences in defensiveness may play a role in the differences between the test-anxious girls and boys. The admittance of anxiety is compatible with the feminine role more so that with the masculine role. Thus high test-anxious girls should be more numerous, psychologically less deviant, more heterogenous, and behaviorally more inconsistent, as a group, than their test-anxious male counterparts. There is some evidence that the girl who is highly defenseive about admitting anxiety is psychologically and behaviorally more deviant among the girls than is the high test-anxious girl.

Summary

Anxiety and Performance on an Ability Test

In general, measures of manifest or general anxiety do not relate significantly with scores of academic ability. (Calvin et al.,1956; Dana, 1957; Faber and Spence, 1955, p. 10; Sarason, I. G., 1960). In general, low to moderate, and usually negative correlations have been observed between test anxiety and ability test performance (Grooms & Endler, 1960; Ruebush, 1963; Sarason, I. G., 1959; Sarason, S.B. & Mandler, 1952; Sarason, S. B. et al., 1960).

Anxiety and Achievement

Many studies have found a negative correlation between anxiety and achievement with the correlation usually being lower than that obtained between anxiety measures of ability. However, some investigators have reported either a positive relationship or none at all (Grooms & Endler, 1960; Ruebush, 1963, p. 498, 499; Sarason, I. G., 1957; Sarason, I.G., 1961; Suinn, 1965; Walter et al., 1964).

Experimental Studies with Psychological Measures of Anxiety

A number of investigators have attempted to find an explanation for the correlation between anxiety and intelligence by using various experimental conditions.

The performance of high anxious individuals under stress has been found to be inferior to that of their low anxious counterparts. (Smith, 1964; Sarason, I. G., & Minard, 1962)

Allison's (1964) investigation resulted in no significant difference in performance between levels of anxiety, whereas Sarason and Palola (1960) found the high anxious individuals to have superior performance in every case except with high anxious instructions and a difficult task. These results reinforce the fact that anxiety is a complex concept.

Sex Differences

Most investigations have shown a greater degree of admittance of test anxiety by girls than by boys. As a result of a study of high and low test anxious subjects Ruebush (1960) and Sarason (1958) report that high test anxious girls present a more favorable impression than do low test anxious girls. From a study of the literature Ruebush (1963, pp. 484, 486, 500), drew some tentative conclusions. He stated that anxiety in boys was related to behavioral indications of dependency toward teachers, social inadequacy, insecurity in plan, and immature game preference.

In general, high test-anxious girls tended to present a more favorable impression than the low test-anxious girls. There was some evidence that the girl who is highly defensive about admitting anxiety is psychologically and behaviorally more deviant among girls than is the test-anxious girl.

CHAPTER IV

METHODOLOGY

The purpose of this chapter is to describe the sample, the procedures used, including the instruments, along with the design and statistical procedures employed.

The Sample

The sample for this investigation consisted of one hundred seniors drawn from government classes of West High School in the Torrance Unified School District near Los Angeles. This school closely parallels national parameters on intelligence and achievement tests. This contributes to the generalizability of the findings. The mean composite score of the first eight tests of the Iowa Test of Educational Development taken in grade eleven was slightly above the national median. The California Test of Mental Maturity (CTMM) scores were not available for these experimental subjects, but the mean IQ for students in the eleventh grade, in the same school during the year of the study, was 103.

Approximately 60 per cent of the class planned to go to college. However, only about 35 per cent actually had transcripts sent to colleges.

High school students were used as subjects in order to avoid the limitations on external validity imposed by using highly select subjects such as volunteer college students. Seniors were chosen for the study because they were in the process of making certain important decisions often revolving around college attendance versus work. Since many of these decisions are largely determined by results of their test performance, it was presumed that an important motivational ingredient would be present in their test-taking behavior.

Place and Conditions for Testing

The conference room of the Assistant Principal served as the experimental setting. Each examinee was seated in a comfortable wooden chair equipped with a desk top providing adequate space for testing and attachments for physiological measurements (see Figure 2). The thermostat was placed at 65° F. and opportunities for distraction were minimized.

Instruments

Measurement of Proficiency

The high and low proficiency categories for purposes of this investigation were determined by the students' scores on the Iowa Test of Educational Development, taken during grade eleven. These scores were obtained from the students' files. Subjects were classified into high and low proficiency groups on the basis of composite score on the Iowa Test of Educational Development. Students whose composite score was below the class mean (56-57 on the composite of test 1-8) were classified as low proficiency and those above the mean were classified as high proficiency.

Measurement of Task Performance

The task of performance was the Cooperative Academic Ability Test, Form A, published by the Educational Testing Service, Princeton, New Jersey. This test, designed for use with college-bound students, yields verbal, mathematical, and total scores. In order for the testing time to conform to the length of the class period, the test was modified by an elimination of every third question, thus reducing the time required by one third. This shortening of the examination reduced the reliability, as computed by the

Spearman-Brown formula, from .88 for the total scores to .84; from .92 for the verbal scores to .87; and from .94 (for the total 100 items) for the mathematical scores to .90.

The questions were placed in order, at random, for their respective sections, verbal and mathematical, by use of a table of random numbers (Kendall and Smith, 1938). This arrangement provided opportunity for individuals unable to complete the test in the time provided to attempt a proportion of the more difficult questions usually placed at the end of a test. A list of the questions in the order presented is provided in Appendix A.

A random half of the subjects was given the test with the verbal section preceding the mathematical section. The other half was given the test with the mathematics section preceding the verbal section. The former arrangement was designated as form A, and the latter form B. This procedure was adopted in order to prevent the results from being contaminated by fatigue, which might lower the scores on the section taken second.

Psychological Measures of Anxiety

The four psychological tests used in the investigation were (a) S-R Inventory of Anxiousness (S-RI), (b) Affect Adjective Check List (AACL), (c) I. G. Sarason's Test Anxiety Scale (TAS), and (d) Bendig's Short Form of Taylor's Manifest Anxiety Scale (MAS). These four instruments (see Appendix A) were stapled together under the title Student Survey. The four tests were labeled only Parts I, II, III and IV.

Physiological Measures of Anxiety

Measures of the following physiological variables were obtained.

Respiration. Respiration measured in respiratory cycles per minute was recorded through a thorax pneumograph leading into the Statham physiological transducer Model P23B. The output of the Statham was led into a DC preamplifier (Model 5P1) and recorded on one channel of the Grass Model 5 Polygraph. Respiration rate and depth were both figured even though the equipment was not designed to yield an accurate quantitative measure of the latter. Consequently, the measurements of respiration depth can serve only to reflect a general trend.

Heart rate. Heart rate was determined by an electrocardiogram (EKG) preamplifier (Model 5P4) of a

Grass polygraph Model 5, equipped with standard limb leads. An electrode coated with a thin layer of sodium chloride electrode paste was placed on the palm surface of the wrist of the nonpreferred hand and on the left leg. Leads II and III were used for the left and right-handed individuals respectively. Lead 1 was not used because its use required electrodes to be placed on both arms. For the test taking task in this investigation freedom of the preferred hand was desired.

Galvanic Skin Response (GSR). The GSR was recorded with a low-level DC preamplifier (Model 5P1) of the Grass Model 5 Polygraph. Sodium chloride electrode paste was applied to the skin-electrode junction. Two silver electrodes, 1/2 inch by 5/8 inch, bent to the contour of the finger, were coated with the electrode paste and securely taped to the palmar surface of the first and third fingers of the nonpreferred hand. Basal GSR resistance levels were recorded in micromhos.

Blood Pressure. Data on the systolic and diastolic blood pressure and pulse pressure were gathered in this study. Blood pressure was measured with a standard cuff and sphygmomanometer on the nonpreferred arm.

Oral and Skin Temperatures. For indicating temperature, a Yellow Springs thermister electronic telethermometer with three probes was used. The three probes were for oral, face, and finger temperatures. Of those providing skin temperatures, one was placed on the palmar surface of the middle finger of the nonpreferred hand, and the other on the cheek. These probes were taped on the indicated surfaces after the areas had been carefully cleansed with alcohol.

Procedures

Several weeks before physiological measures were taken, the investigator administered the four psychological tests of anxiety to all prospective subjects.

Selection of the Sample

There were 280 students in the senior government classes available for the experiment. Approximately 20 were eliminated from this group because either their scores on the Iowa Tests of Educational Development or complete scores on the psychological tests were not available. From the remaining 260 prospective subjects, a group of 130 was chosen at random, and balanced according to sex and proficiency level as determined by the ITED. In compliance with the school's requirements, letters requesting parental consent were sent to the homes of the 130 prospective subjects. (See Appendix A). In the event that these letters were not returned, the investigator contacted the parents by telephone in order to preserve the character of the sample. Approximately one month later a second lot of approximately 20 letters was sent out in order to supply enough subjects to replace those for whom parental consent was not secured. This group was selected by the same method as the first. From these two lots, parental consent was finally secured for 131 subjects. Records were taken for all but one of these. The data for 30 of the subjects was then discarded either because of technical difficulties undergone during the testing or in the case that their performance was measured only in order to perfect the instrumentation procedures. The data from the remaining 100 subjects were used in the analysis. To the extent that this procedure limited the selectivity of the sample, bias was introduced.

Assignment to Treatment Groups

The 100 subjects, counterbalanced for sex and proficiency level[1] were in turn subdivided into five groups, also counterbalanced for sex and proficiency levels.[2]

Since research has shown physiological measures to vary with the time of the day, digestion of food, and season of the year (Best & Taylor, 1961, pp. 274-276, 302, 884, 1270, and Wenger & Ellington, 1943), special precaution was taken to have individuals assigned at random to treatments, day of testing, and time of day. As computed by analysis of variance, there was no significant relationship between the treatment groups with respect to day, time of test, and date the letter of approval was received (see Tables 45-47). In order to facilitate the selection of subjects, the names of the students were listed alphabetically according to class period, with a plus or minus symbol indicating proficiency level and M or F indicating sex.

A schedule was then compiled designating the sex and proficiency level of the subjects required for each period of the day and the type of treatment and form of examination (form A or form B) to be administered.

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[1] The group of 100 subjects was composed of 25 low-proficiency boys, 25 high-proficiency boys, 25 low-proficiency girls, and 25 high-proficiency girls.

[2] Each of the five groups was composed of 5 low-proficiency boys, 5 high-proficiency boys, 5 low-proficiency girls, and 5 high-proficiency girls.

An available student possessing the required characteristics as to proficiency level and sex was then administered the treatment planned for that period.

Treatments

Of the five treatment groups, three received stimuli in the form of test instruction, and two served as controls. Figure 1 illustrates the design.

The treatment instructions were read by one of the classroom teachers and recorded on tape prior to the treatment situation. This recording was then played as the anxiety stimuli for the treatment situation, thereby assuring a standard presentation of the instructions to the subjects. Physiological measures were taken for each subject while he took the Academic Ability Test.

Treatment One--Anxiety-reducing Instructions (ARI). The following instructions for this treatment group were intended to reduce feelings of anxiety or concern because of the test:

> We are conducting a research project concerning examinations. The test you are about to take is very long and difficult so do not be concerned if you are not sure of all the answers or cannot finish within the given time. No one will find it easy. We wish to make it clear that this is purely for research purposes and will have nothing to do with any course offered at West High. Attempt the

$O_1 \quad X_{ARI} \quad O_2 \quad O_T$

$O_1 \quad X_{NI} \quad O_2 \quad O_T$

$O_1 \quad X_{API} \quad O_2 \quad O_T$

$O_1 \quad X_{CPM} \quad O_2$

$\quad X_{CTP} \quad O_2^1 \quad O_T$

X_{ARI} : Anxiety-reducing instructions
X_{NI} : Neutral instructions
X_{API} : Anxiety-producing instructions
X_{CPM} : Control for physiological measures
X_{CTP} : Control for test performance
O_T : Test performance
O_1 O_2 : Physiological variable data

[1] Physiological measures taken after completion of the test.

Figure 1. Treatment Groups Design (Campbell-Stanley notation)

> questions in the order they come--do not skip around. We wish to thank you for your cooperation in this research.
>
> Please follow the General Directions on the front of the test booklet and on page three.

Treatment Two--Neutral Instructions (NI). The neutral instructions, phrased neither to reduce nor to produce anxiety, were the standard instructions that came with the test. These instructions were as follows:

> The test you are about to take is an Academic Ability Test. Attempt the questions in the order they come--do not skip around. Please follow the General Directions on the front of the test booklet and on page three.

Treatment Three--Anxiety-Producing Instructions (API). The anxiety producing instructions were designed to elicit a high degree of anxiety by placing emphasis on the importance of the examination. The anxiety-producing instructions were as follows:

> The test you are about to take is a college ability intelligence test. This test has been found to predict such things as course grades, success or failure in college, success or failure in various types of occupations, and success or failure in later life. Of course, your own intelligence will primarily determine whether you do well or poorly on this test. Therefore, it is an extremely important examination and you should try to do your very best.
>
> At a later date the scores will be posted so your score can be compared with others who have taken the test.

> Your teachers and counselors will be given your results so be sure to try your very best on all questions. Attempt the questions in the order they come--do not skip around. Remember it is important for you to concentrate at all times.
>
> Please follow the General Directions on the front of the test booklet and on page three.

Treatment Four--Control for Physiological Measure (CPM). Students in the control group for physiological measures had their physiological responses recorded by the same methods as the first three groups, but participants read a given section in their government books in lieu of taking the test. This group served as a control for physiological measures in that it provided a record of the physiological responses independent of test performance in order to detect changes due to peculiarities in the experimental environment, instrumentation, fatigue, et cetera.

Treatment Five--Control for Test Performance (CTP). Students in the control group for test performance had the same neutral instructions as Treatment Two, and took the Academic Ability Test, but with no concomitant physiological measures. After the completion of the test, pulse rate, systolic blood pressure, diastolic blood pressure, and oral temperature were taken. Group five served as the control for test performance in that it provided a measure of the examinee's performance on the ability test, independent of the presence of the instrumentation for physiological measures.

The equipment for securing physiological measures was allowed to warm up approximately one-half hour before use. All bodily surfaces that were to have electrodes attached were thoroughly cleansed with 70 per cent alcohol. Before use with each subject, the electrodes were cleansed with alcohol and, when necessary, with steel wool in order to provide good contact. The oral temperature probe was allowed to stand in a solution of aqueous zephiran chloride 1:750[1] and in a solution of 70 per cent alcohol after use with each subject.

Process of Testing

After the student was directed to the appointed chair for testing in the treatment room, the electrodes and attachments for the physiological measures were placed in the appropriate locations on the examinee as pictured in Figure 2.

Shown in the foreground of Figure 3 is the

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[1] One part zephiran chloride to 750 parts distilled water.

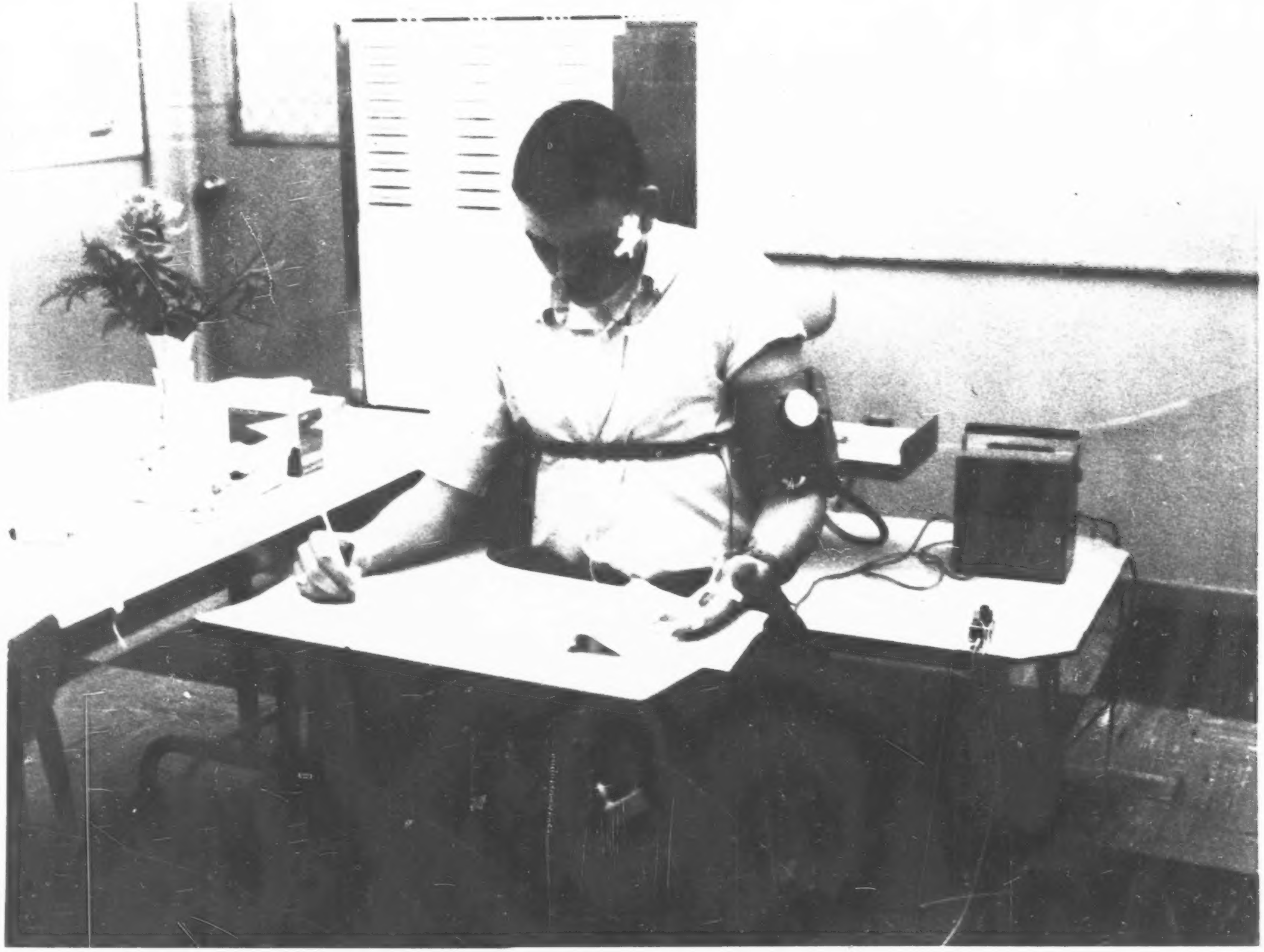


Figure 2. A Student Performing

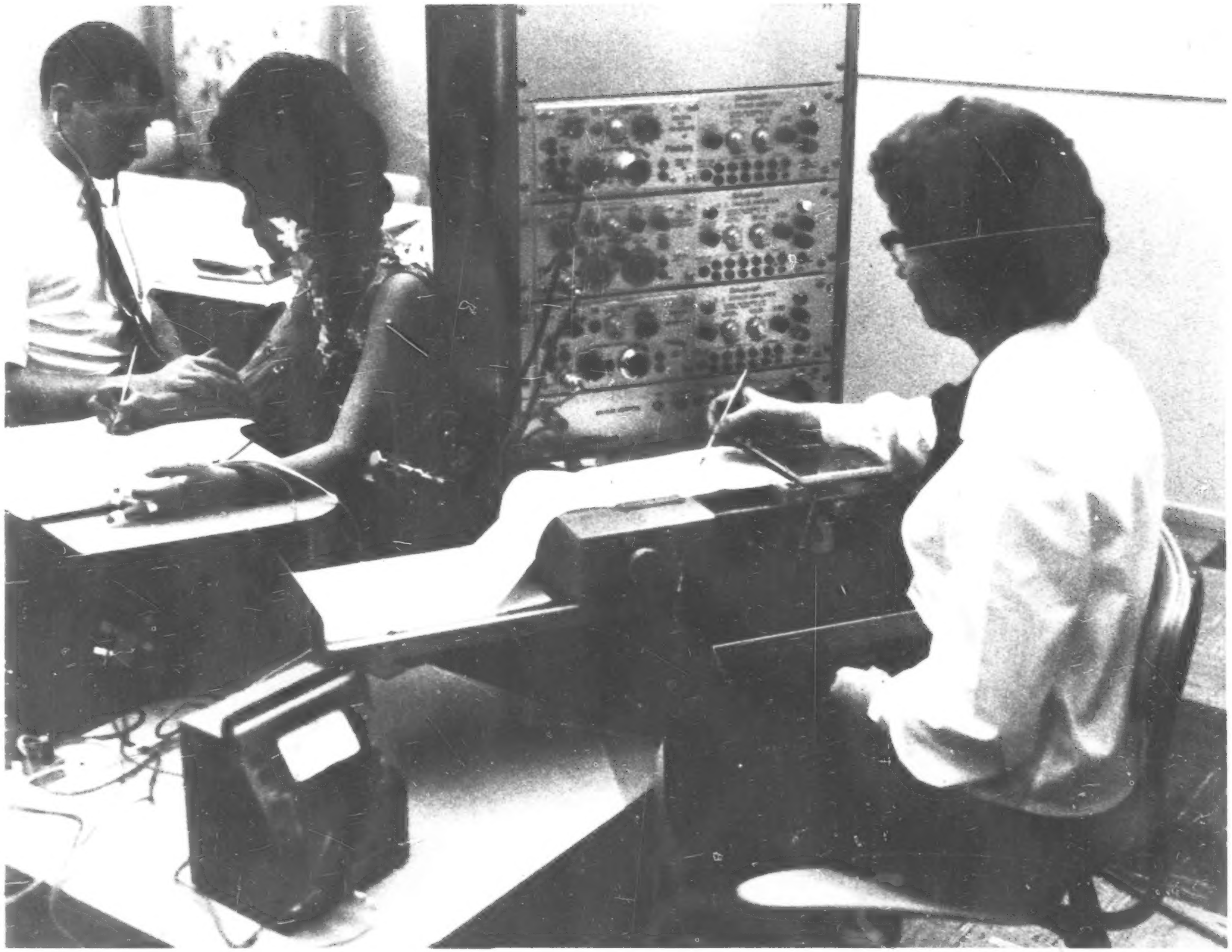


Figure 3. The Grass Polygraph

Grass polygraph that recorded the respiration, EKG, and GSR. To the left of this in the same picture, is the thermister electronic telethermometer.

While the electrodes were being attached the subject completed the background information required on the top of the answer sheet, read the directions for the test, and asked questions if he wished to do so. Before the initiation of the experimental period, subjects were allowed to become accustomed to the recording apparatus and pretest readings were recorded for all physiological measures.

The anxiety stimuli in the form of instructions were given by a tape recorder. This method was used in order to standardize the presentation. Following the introduction of the anxiety stimuli, the student was administered the Affect Adjective Check List with the directions to check it according to his present feelings. This questionnaire had also been presented to each subject two weeks earlier as a part of the student survey. The scale was given on the two occasions in order to determine the relationship between the introspective evaluation of his usual feelings during an examination and his evaluation just prior to the testing event. Following completion of the AACL, the examinee immediately began work on the Academic Ability Test. Concomitant physiological measures were recorded throughout the testing. The completion of each question was monitored by an event marker on the recording paper of the polygraph. This monitoring indicated the time required for answering the question. A portion of this graph paper, presented in Figure 4, indicates respiration, the monitoring of the question, the EKG, and the GSR. Paper speed was 2.5 mm. per second.

While the student performed on the Academic Ability Test, continual measurements were recorded from prereading to postreading for respiration rate, respiration depth, EKG, and GSR.

The subject's blood pressure was taken on three occasions: once immediately before beginning the test, once immediately after the completion of the first half of the test, and a third time immediately after the completion of the second half of the test.

Cheek, finger, and oral temperatures were taken on four occasions: once immediately after the completion of the AACL, and again on each of the three above occasions at the same times as the blood pressure readings.

Analysis of Data

As illustrated in Figure 5, the principal

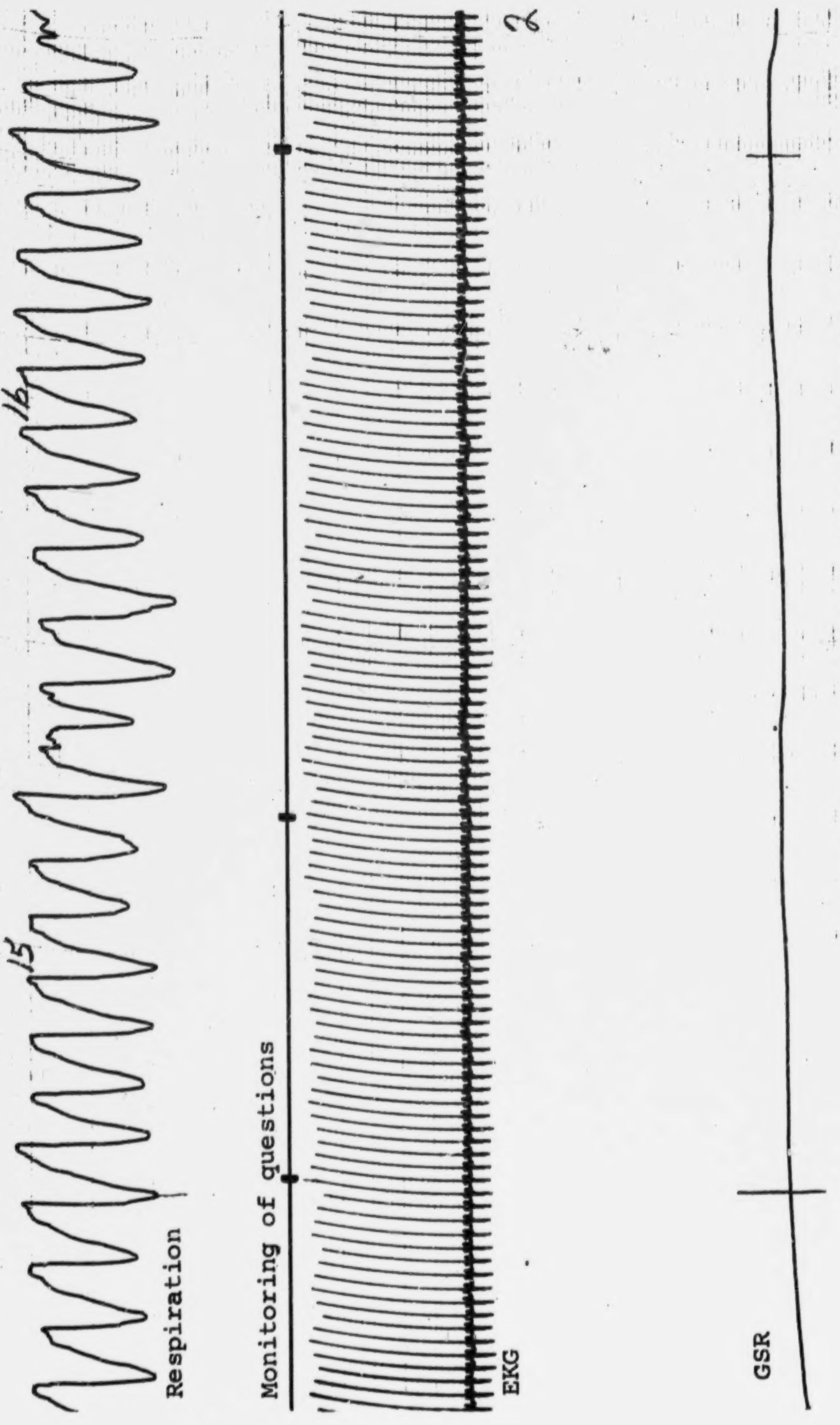


Figure 4. A portion of the polygraph record

statistical model employed for the experiment was a balanced 4 x 2 x 2 (type of instructions x level of proficiency x sex) fixed effects model of analysis of variance and covariance. A 5 per cent level of significance was employed throughout.

Analyses of variance on the Academic Ability Test were run for the total score of the test, on the verbal and mathematical sub-tests, and on the ten physiological measures, namely:

a. respiration rate
b. respiration depth
c. heart beat rate
d. galvanic skin response
e. systolic blood pressure
f. diastolic blood pressure
g. pulse pressure
h. oral temperature
i. face temperature
j. finger temperature

An analysis of covariance was computed on the Academic Ability Test for the total, verbal, and mathematical scores with the initial anxiety level for each of the physiological measures separately held constant.

Correlations were computed between the following measures for each treatment group:

A. Physiological measures were correlated with:
   1. Other physiological measures of anxiety
   2. Psychological measures of anxiety
   3. Total, verbal, and mathematical scores of the Academic Ability Test

B. Psychological measures were correlated with:
   1. Total, verbal, and mathematical scores of the Academic Ability Test.

C. The Affect Adjective Check List given prior to the major testing was correlated:
   1. With the same scale given after the anxiety instructions for the ability test.

D. Psychological measures were correlated with:
   1. Psycnological measures for the 100 examinees.

Summary

Problem

The principal problems of the study concerned the following issues: (a) the extent to which anxiety influences ability test performance; and (b) the extent to which various physiological and psychological

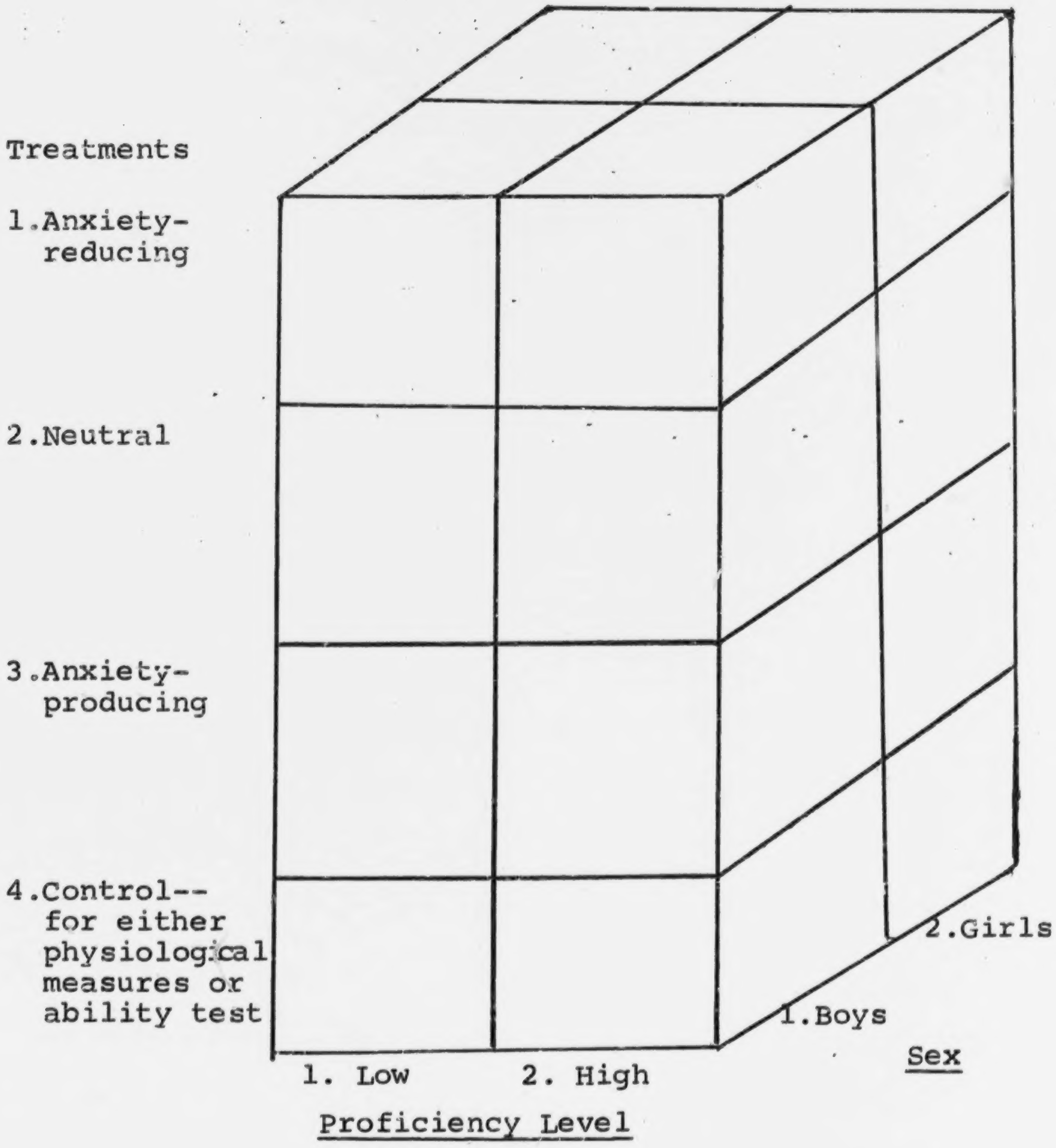

Treatments
1.Anxiety-reducing
2.Neutral
3.Anxiety-producing
4.Control--for either physiological measures or ability test
1. Low
2. High
Proficiency Level
1.Boys
2.Girls
Sex

Figure 5. The Statistical Model Within Which The Data Was Analyzed

measures of anxiety are related.

Procedures

All high school seniors enrolled in any of the nine sections of the United States Government classes at West High School in the Torrance Unified School District were administered the following four self-report anxiety measures: S-R Inventory of Anxiousness, Affect Adjective Check List; Test Anxiety Scale, and the Manifest Anxiety Scale.

One hundred of the students, counterbalanced for sex and high and low proficiency levels, were in turn subdivided, at random, into five groups, also counterbalanced for sex and proficiency levels.

The five groups were composed of three treatment groups and two controls. The treatment groups received anxiety reducing, neutral, or anxiety producing instructions presented by a tape recorder before being administered the Academic Ability Test. While performing on the test respiration rate and depth, heart beat rate, GSR, systolic and diastolic blood pressure, pulse pressure, and oral, face, and finger temperatures were taken.

One control group had physiological measures recorded but read in their government books in lieu of taking the ability test. The other control group took the ability test with neutral instructions but no physiological measures were taken until the completion of the test, and then only pulse rate, oral temperature, and systolic and diastolic blood pressures were taken.

Analysis of the Data

The basic statistical model was a three-way analysis of variance (treatments x proficiency levels x sex). The dependent variables included the verbal, mathematical, and total ability test scores, and the physiological and psychological measures of anxiety. Analyses of covariance with the same factorial design was also carried out with the ability test scores, using the initial level of anxiety (prereadings) held constant. Correlational analyses were performed on all anxiety measures and the ability test scores.

CHAPTER V

RESULTS

This chapter presents the results of the investigation in terms of the hypotheses, and provides a discussion of the findings.

Hypothesis One

Anxiety will influence test performance in the following ways:

A. Anxiety-reducing test instructions will result in highest levels of performance on an ability test.

B. Neutral test instructions will result in medium levels of performance on an ability test.

C. Anxiety-producing instructions will result in lowest levels of performance on an ability test.

Results and Discussion

As observed in Tables 1-3, the results of the analysis of variance indicated no significant difference

TABLE 1

Results of Analysis of Variance for the Total Score of the Academic Ability Test

Source of Variation	df	Mean Square	F
A-Instruction	3	27.80	.66
B-Proficiency	1	3250.59	77.56**
C-Sex	1	.26	.01
A X B	3	29.10	.69
A X C	3	83.65	2.00
B X C	1	1.10	.03
A X B X C	3	79.5	1.90
Within	64	41.91	
Total	79		

**Significant at .01 Level

TABLE 2

Results of Analysis of Variance for the Verbal Score of the Ability Test

Source of Variation	df	Mean Square	F
A-Instruction	3	9.00	.67
B-Proficiency	1	825.76	61.08**
C-Sex	1	90.75	6.71*[a]
A X B	3	55.69	1.88
A X C	3	11.84	.88
B X C	1	5.80	.43
A X B X C	3	9.41	.70
Within	64	13.52	
Total	79		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 3

Results of Analysis of Variance for the Mathematical Score of the Ability Test

Source of Variation	df	Mean Square	F
A-Instruction	3	18.52	1.20
B-Proficiency	1	796.69	51.44**
C-Sex	1	138.39	8.94**[a]
A X B	3	3.74	.24
A X C	3	41.70	2.69
B X C	1	1.71	.11
A X B X C	3	37.01	2.39
Within	64	15.49	
Total	79		

**Significant at .01 Level

[a] Boys > Girls

in performance between the treatment groups, although the means for the total, verbal and mathematical scores for subjects of both sexes under the influence of the instruction treatments were as predicted, except for those of the subjects given anxiety-producing instructions (observe Table 4). For this group, the scores showed an increase rather than a decrease. The means are presented in Table 1, and the graphic presentation for the three types of scores is provided in Figure 6. As can be seen, the means for all three scores[1] follow similar patterns, a graphic presentation of the three types of scores (total, verbal, and mathematical) is provided in Figures 7-9.

The lack of a significant difference in performance among the groups with different types of anxiety instructions may indicate that the instruction stimuli did not manipulate anxiety. This is a highly plausible explanation in light of the analysis of the physiological variables, which revealed no significant difference among the three instruction stimuli groups other than respiration rate.

In reality, there is no way to measure exactly how the students perceived the instruction stimuli.

---

[1] Total score was divided by two for comparison.

TABLE 4

Means and Standard Deviations for the Total, Verbal and Mathematical Scores on the Academic Ability Test

Means and Standard Deviations for Total Score

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	28.10	9.49	24.50	8.87	26.30	9.18
Neutral	25.60	8.55	23.40	9.78	24.50	9.16
Anxiety-Producing	23.70	10.84	29.50	10.93	26.60	10.88
Total	25.80	9.63	25.80	9.86	25.80	9.74
Control for Test Performance	26.50	8.49	24.90	8.36	25.70	8.42
Total	25.98	9.34	25.58	9.48	25.78	9.41

TABLE 4--(Continued)

Means and Standard Deviations for Verbal Score

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	12.70	5.29	14.00	4.97	13.35	5.13
Neutral	13.00	4.69	13.20	5.05	13.10	4.87
Anxiety-Producing	12.10	5.20	16.30	6.34	14.20	5.77
Total	12.60	5.06	14.50	5.45	13.55	5.26
Control for Test Performance	11.50	2.59	13.90	5.51	12.20	4.05
Total	12.32	4.44	14.35	5.48	13.34	4.96

TABLE 4--(Continued)

Instruction Groups	Means and Standard Deviations for Mathematical Score					
	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	16.20	4.52	10.50	4.30	13.35	4.41
Neutral	12.60	4.84	10.20	5.05	11.40	4.94
Anxiety-Producing	12.20	6.60	13.20	5.45	12.70	6.02
Total	13.67	5.32	11.30	4.93	12.48	5.12
Control for Test Performance	15.00	6.60	11.00	3.59	13.00	5.10
Total	14.00	5.44	11.22	4.60	12.61	5.12

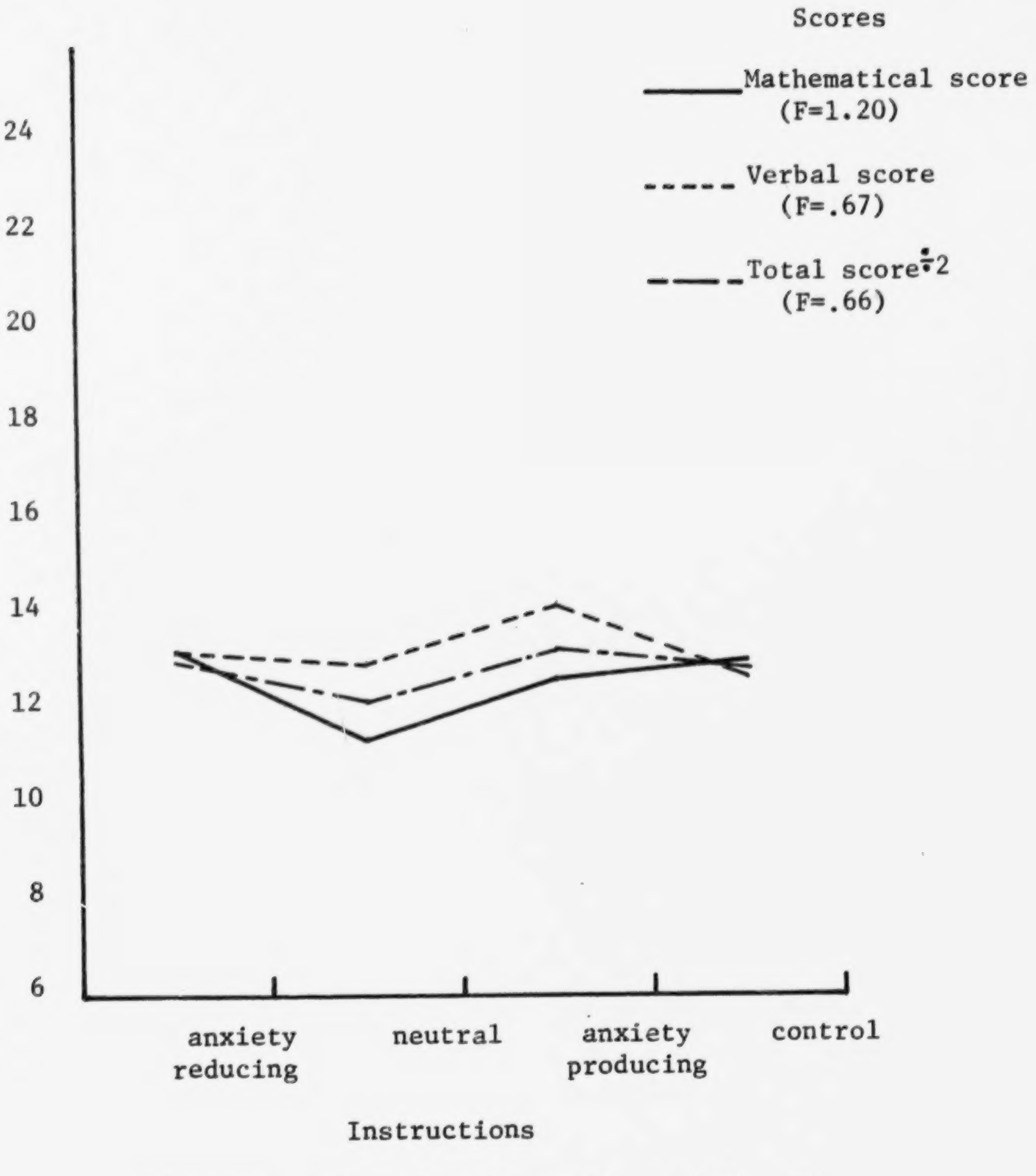
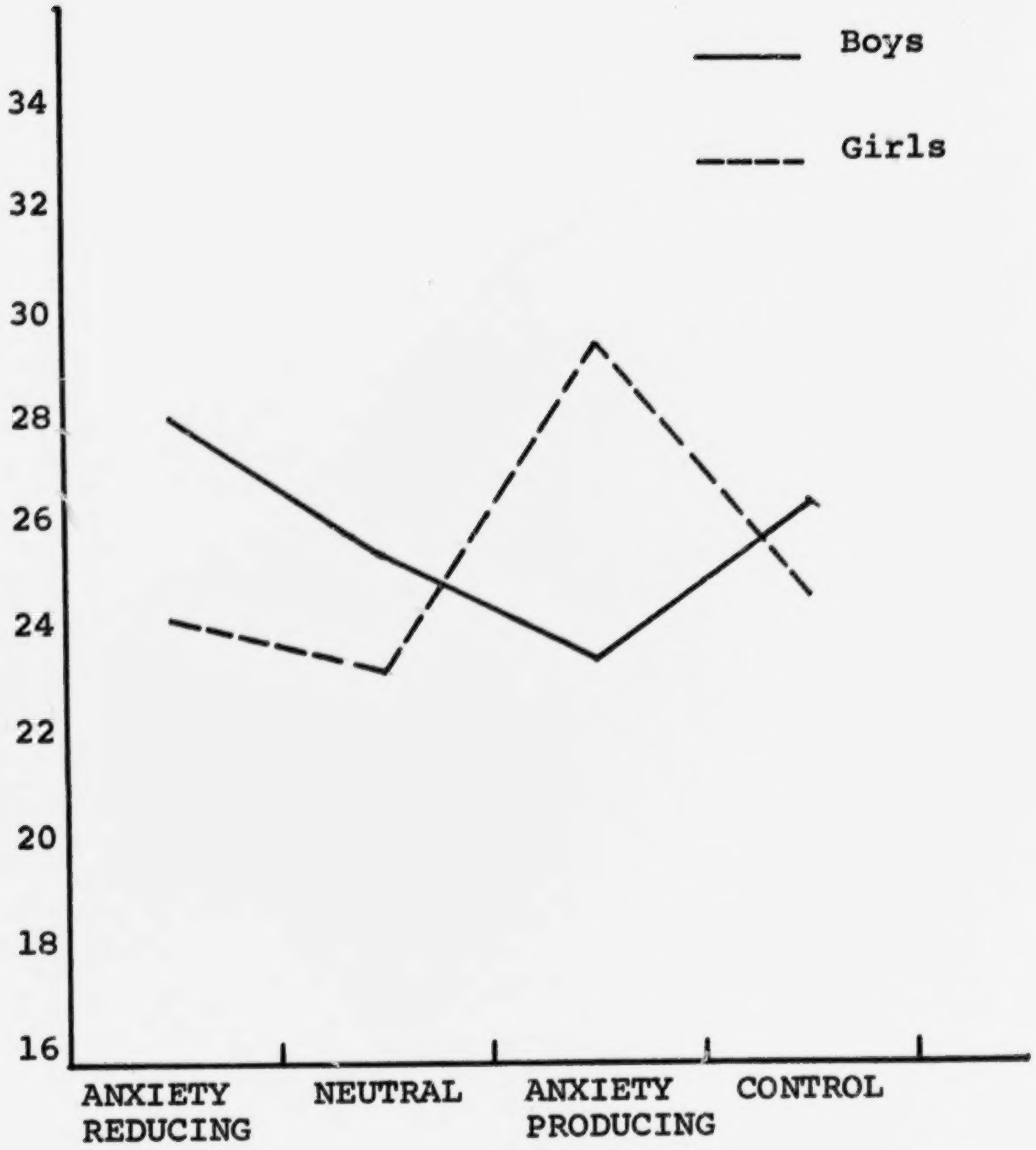


Figure 6. Means for the total, verbal, and mathematical scores for the anxiety reducing, neutral, and producing instruction groups, and for the control group for test performance.



INSTRUCTIONS

Figure 7 Means for the total test scores for the anxiety-reducing, neutral, and anxiety-producing instruction groups and the control for test performance.

Treatment F = .66 NS

Sex F = .01 NS

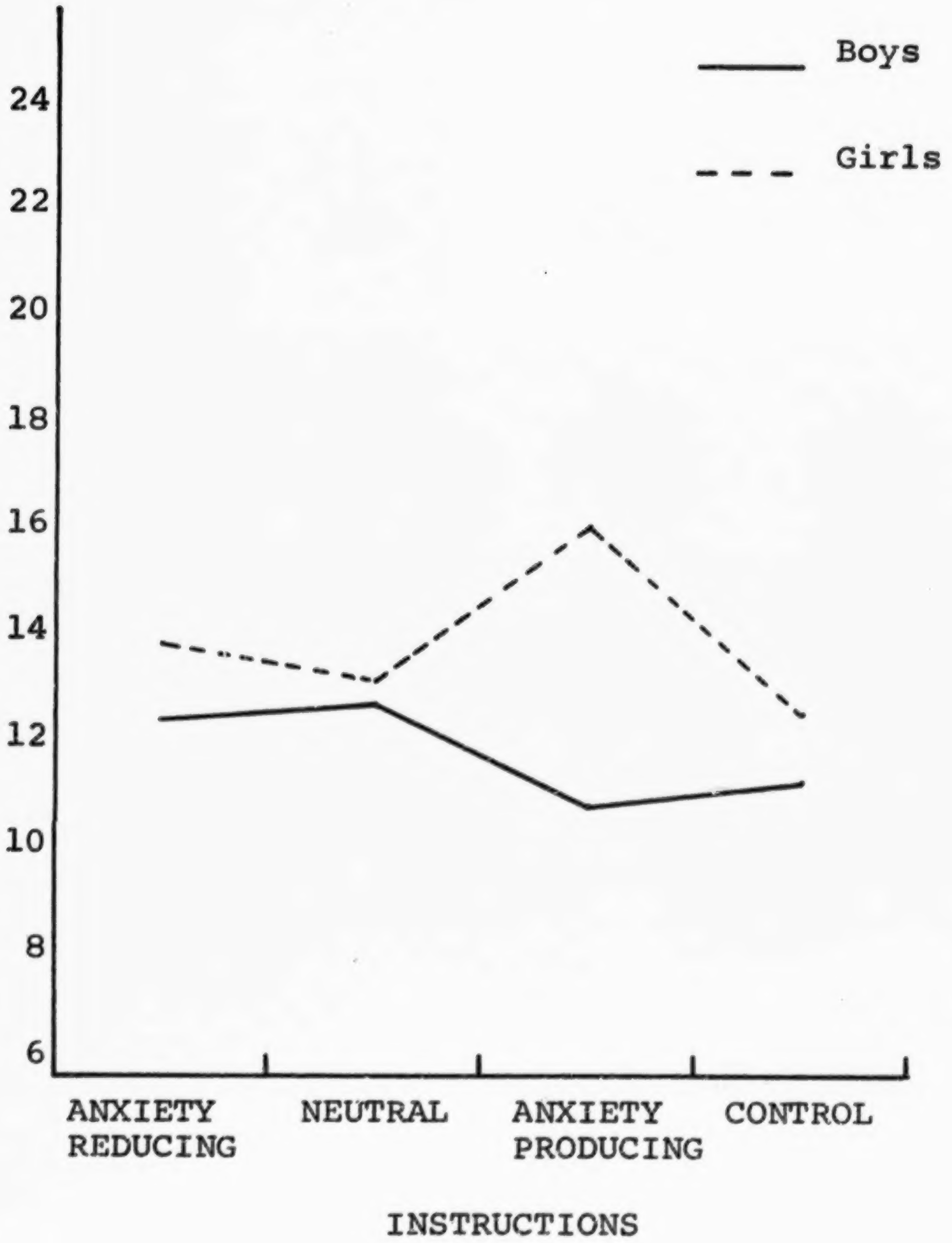


Figure 8 Means for the verbal score for the anxiety-reducing, neutral, and anxiety-producing instruction groups and the control for test performance for boys and girls.

Treatment F = .67 NS

Sex F = 6.71 $p < .05$

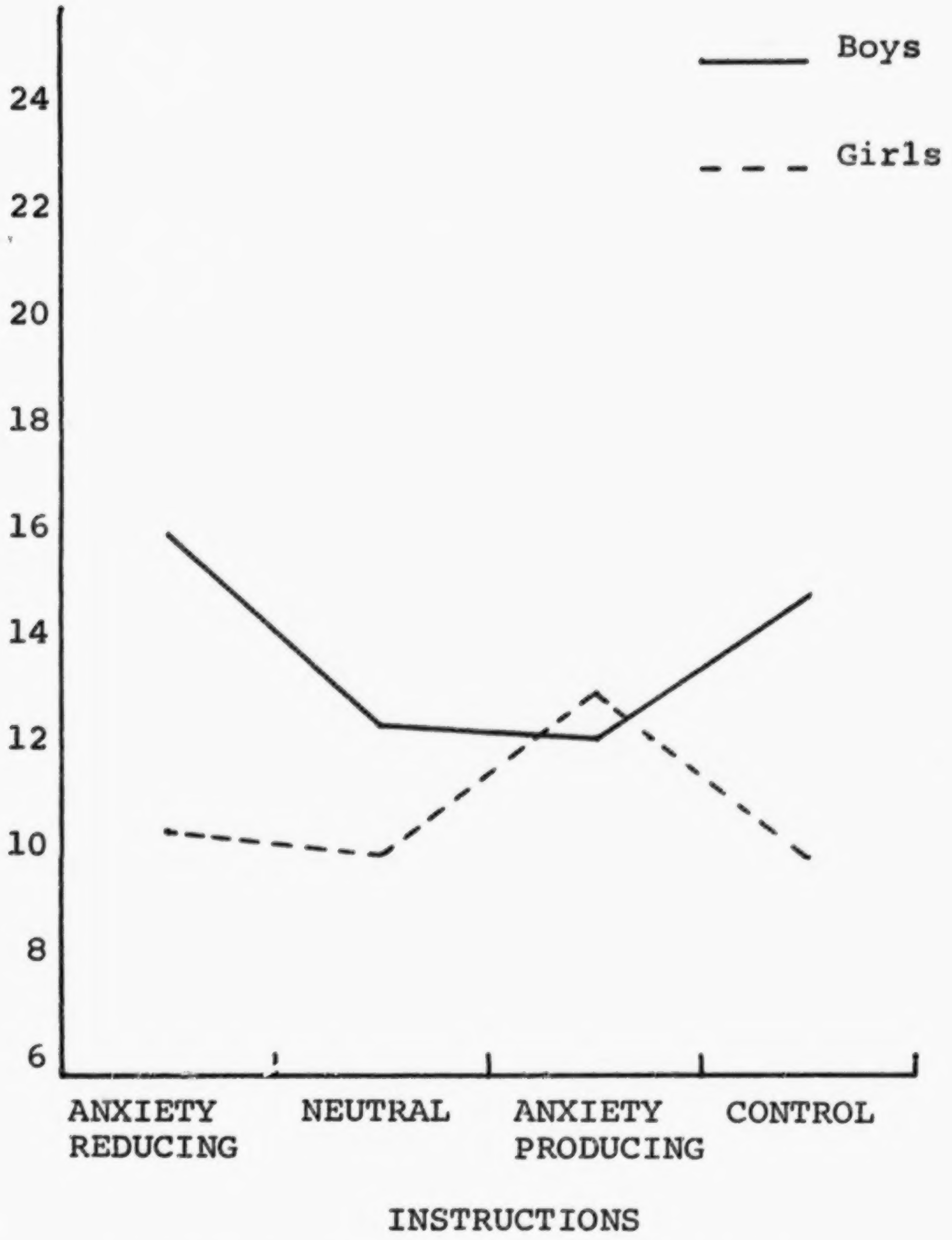


Figure 9 Means for the Mathematical scores for the anxiety-reducing, neutral, and anxiety-producing instruction groups and the control for test performance.

Treatment F = 1.20 NS

Sex F = 8.94 $p < .01$

Since their participation was not compulsory, and since the test was presented in an experimental setting by personnel external to the school staff, the students might have reasoned that the results could not possibly have been of any consequence to them. Reasoning of this sort may have reduced any feeling of anxiety.

The instructions were given by recorded tape in order to standardize the presentation. This means of administration might have been so impersonal that the impact of the anxiety stimulus was not communicated. Consequently, the subjects may have been little disturbed irrespective of what was intended to be threatening or non-threatening.

It is also possible that the anxiety of anticipation of the ability test was at a peak before the subjects received the treatment instructions. Some subjects said they felt they were being used as "guinea pigs." Many were perspiring profusely even though the weather was not warm. Peterson, Keith, and Wilcox (1962) found the anxiety of anticipation to be quite the same as the anxiety experienced during the stress-provoking event as measured by cholesterol level. If the students were at the peak of their anxiety potential before the instructions for the ability test were presented, they might not have experienced any increased anxiety. This explanation is contraindicated, however, since there was no consistent pattern of correlation between level of anxiety measurement and test performance.

Martin and McGowan (1955), using only palmar skin conductance, found no significant difference in performance between low and high anxious groups, as evaluated by Mandler and S. B. Sarason's Test Anxiety Questionnaire. They concluded that, "apprehension about the experimental session itself overshadowed concern about the course examination for both groups," if the apprehension about one physiological measure overshadowed concern about the examination, the multiple measures in the present investigation might be thought to overshadow the concern about the test to an even greater extent. The fact that the physiologically measured anxiety did not have means differing from the control group contraindicates this explanation.

CONCLUSION

Hypothesis one, that variations in "anxiety-producing" instructions produce differences in performance on an ability test could not be rejected.

Hypothesis Two

The degree of anxiety elicited by the instructions will influence test performance in the following ways when the initial level of anxiety is held constant:

A. Anxiety-reducing test instructions will result in the highest level of performance on an ability test.

B. Neutral test instructions will result in medium levels of performance on an ability test.

C. Anxiety-producing instructions will result in lowest levels of performance on an ability test.

Before the analysis of covariance was computed, several of the physiological variables were plotted with test scores to confirm linearity. Since the recordings for the galvanic skin response (GSR) and the respiration depth were not absolute measures, changed scores (the difference between the prereading and the mean test reading) were used. In view of the fact that the members of the groups were selected at random, it was assumed that there would be no significant difference between the treatment groups for the prereadings. This assumption was confirmed by several analyses of variance for the prereadings. There were no significant differences between the treatment groups for the prereadings for any of the other physiological measures tested (all tested except GSR, Respiration depth and two others), (observe Tables 48-53 in Appendix B). The means for the prereadings are presented in Tables 54-63 in Appendix B.

Results and Discussion

As can be observed in Table 5 and in Tables 64-111 in Appendix B, there was no significant difference in performance among treatment groups when the pre-reading for the physiological measures were held constant. The lack of significance between the treatment groups was also true when the control group was included, using the physiological measures that were taken at the completion of the test for the control group (Tables 100-111). Therefore, hypothesis two was rejected since the F values for scores with physiological measures held constant were nonsignificant (see Table 5).

In every case, the F value of the analysis of variance for the mathematical scores for the three instruction groups with the initial physiological measures held constant was greater than that of the total or verbal scores. However, in no case did any of the F values attain the .05 level of significance. It was also interesting to note that the F values for all the scores with the initial physiological measures held constant were in almost every case higher than when the initial physiological measures were ignored.

TABLE 5

Summary of Results of Analysis of Covariance for the Total, Verbal, and Mathematical Scores for With and Without the Initial Anxiety Held Constant

Measures	F for total score	F for verbal score	F for Math. Score
AAT Scores without Initial Anxiety held Constant	.66	.67	1.20
AAT with the following Measures hald Constant			
Respiration Rate	1.21	1.00	1.29
Respiration Depth[a]	1.16	1.11	1.33
Heart Beat Rate	1.16	1.14	1.66
GSR[a]	.92	1.02	1.16
Systolic B.P.	.97	1.00	1.15
Diastolic B.P.	.53	.24	1.16
Pulse Pressure	.71	.61	1.14
Oral Temp.	.98	.76	1.31
Face Temp.	1.17	1.10	1.36
Finger Temp.	.84	.76	1.22

[a] Differences between the prereading and test reading used as the covariate.

Analysis of variance for the ability test without the prereadings for the physiological measures held constant (observe Table 1-3) revealed no instruction x sex interaction for the total, verbal, or mathematical scores and no six difference for the total scores. However, there were sex differences for the verbal and mathematical scores, with the girls superior on the verbal and the boys superior on the mathematical scores.

The analysis of covariance for the ability test with the initial readings for the physiological measures held constant was computed to determine the performance on the ability test with only the influence of the anxiety during the test present. (Tables 64-111 in Appendix B). In other words, the analysis of covariance was computed to determine the performance on the ability test with the initial anxiety level held constant. Table 6 presents a summary of the results, with each physiological measure. The girls' verbal scores were significantly superior to those of the boys, but only with finger temperature held constant were the boys' scores still significantly superior to the girls' score on the mathematical section.

In order to study these findings, the means for the ability test were adjusted for the initial

TABLE 6

Summary of Results of Analysis of Variance for Sex and Instruction X Sex Interaction for Total, Verbal, and Mathematical Scores when the Initial Anxiety for Each of the Physiological Measures was Held Constant

Scores	Sex		Instruction X Sex Interaction	
Measures	F	Significance	F	Significance
Resp. Rate				
Total	1.05	N S	4.14	< .05
Verbal	5.14	< .05 G < B	2.31	N S
Math.	3.47	N S	3.55	< .05
Resp. Depth				
Total	0.06	N S	4.00	< .05
Verbal	4.33	< .05 G < B	2.06	N S
Math.	3.88	N S	3.65	< .05
Heart Beat Rate				
Total	0.30	N S	4.14	< .05
Verbal	5.44	< .05 G < B	2.41	N S
Math.	3.15	N S	3.81	< .05
GSR				
Total	0.19	N S	4.01	< .05
Verbal	5.68	< .05 G < B	2.49	N S
Math.	3.97	N S	3.34	< .05
Systolic B.P.				
Total	0.62	N S	4.31	< .05
Verbal	6.76	< .05 G < B	2.64	N S
Math.	2.15	N S	3.87	< .05
Diastolic B.P.				
Total	0.47	N S	4.25	< .05
Verbal	7.65	< .01 G < B	2.41	N S
Math.	3.18	N S	3.76	< .05
Pulse Pressure				
Total	1.38	N S	5.87	< .01
Verbal	10.22	< .01 G < B	4.24	< .05
Math.	1.73	N S	4.62	< .05
Oral Temp.				
Total	0.43	N S	3.49	< .05
Verbal	7.45	< .01 G < B	1.68	N S
Math.	3.10	N S	3.44	< .05
Face Temp.				
Total	0.27	N S	3.90	< .05
Verbal	4.67	< .05 G < B	2.47	N S
Math.	2.80	N S	3.29	< .05

TABLE 6--(Continued)

Scores	Sex		Instruction X Sex Interaction	
Measures	F	Significance	F	Significance
Finger Temp.				
Total	0.00	N S	3.56	$< .05$
Verbal	4.17	$< .05$ G $<$ B	2.18	N S
Math.	4.91	$< .05$ B $<$ G	3.14	N S

anxiety level for the total, verbal, and mathematical scores for five of the physiological measures. Since the adjusted means were essentially identical with the unadjusted means, due to the high comparability of treatment groups on the prereadings (as would be expected from random assignment) and the low correlation between the covariates and the dependent variable, additional adjusted means of more measures were not computed. The adjusted and unadjusted means are presented in Tables 7-11. As can be observed in Figures 10-24, the adjusted and unadjusted means do not vary greatly.

Hypothesis Three

The degree of anxiety elicited by the instructions will influence physiological responses during test performance in the following ways:

A. Anxiety-reducing test instructions will result in the lowest physiological responses.

B. Neutral test instructions will result in medium responses.

C. Anxiety-producing instructions will result in the highest physiological responses.

TABLE 7

Unadjusted Means and Adjusted Means with
The Respiration Rate Held Constant for
the Ability Test with the Three Type
of Instruction

	Boys		Girls	
Groups	Unadj. Means	Adj. Means	Unadj. Means	Adj. Means
Total Score				
A-Reducing I	28.10	28.20	24.50	24.06
Neutral I	25.60	25.82	23.40	23.22
A-Producing I	23.70	23.92	29.50	29.49
Verbal Score				
A-Reducing I	12.70	12.66	14.00	14.11
Neutral I	13.00	12.94	13.20	13.25
A-Producing I	12.10	12.04	16.30	16.30
Mathematical Score				
A-Reducing I	16.20	16.26	10.50	10.34
Neutral I	12.60	12.68	10.20	10.14
A-Producing I	12.20	12.28	13.20	12.80

n = 20

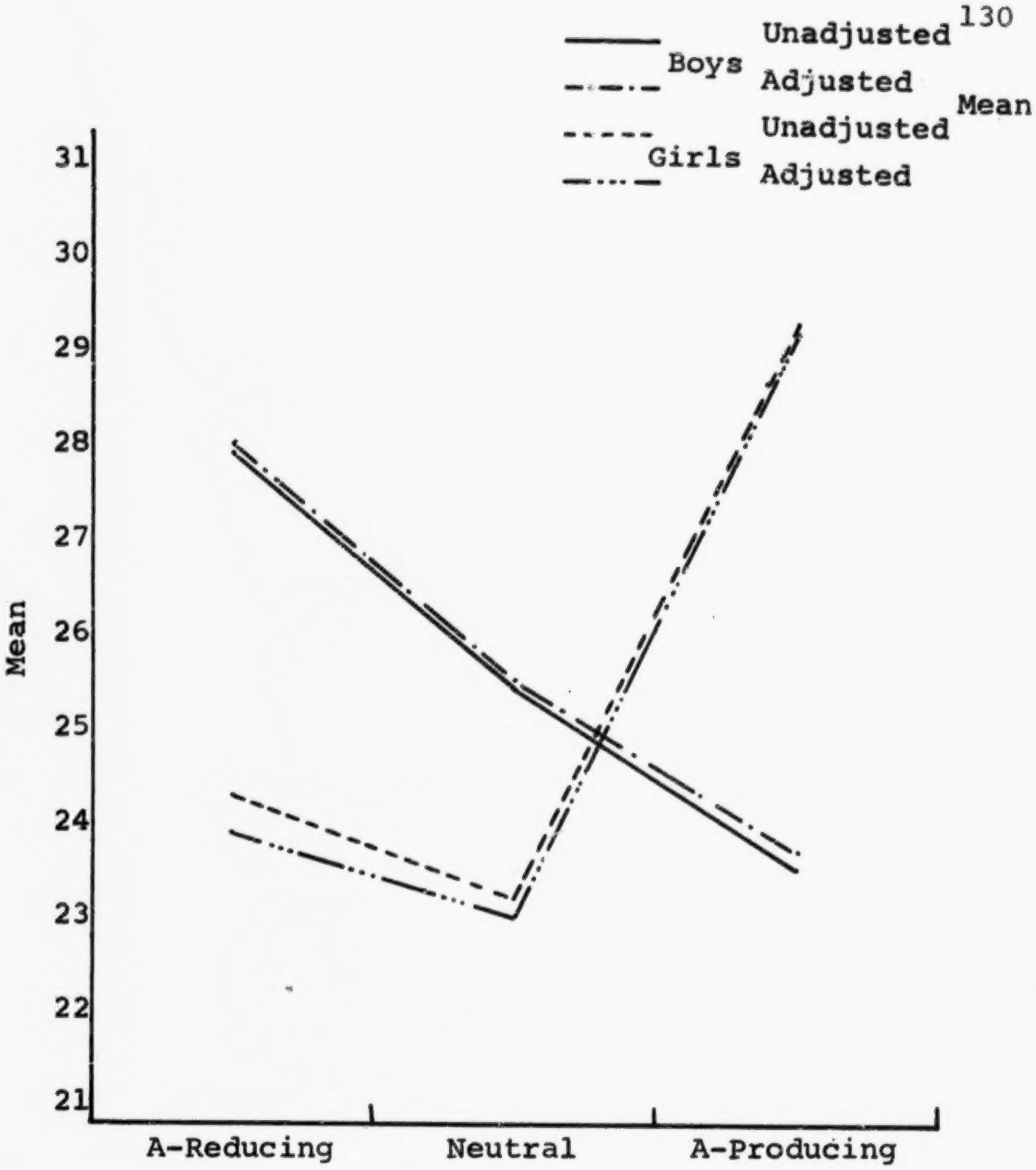


Figure 10 Unadjusted and adjusted means with the initial respiration rate held constant for the total test scores with the three types of instruction.

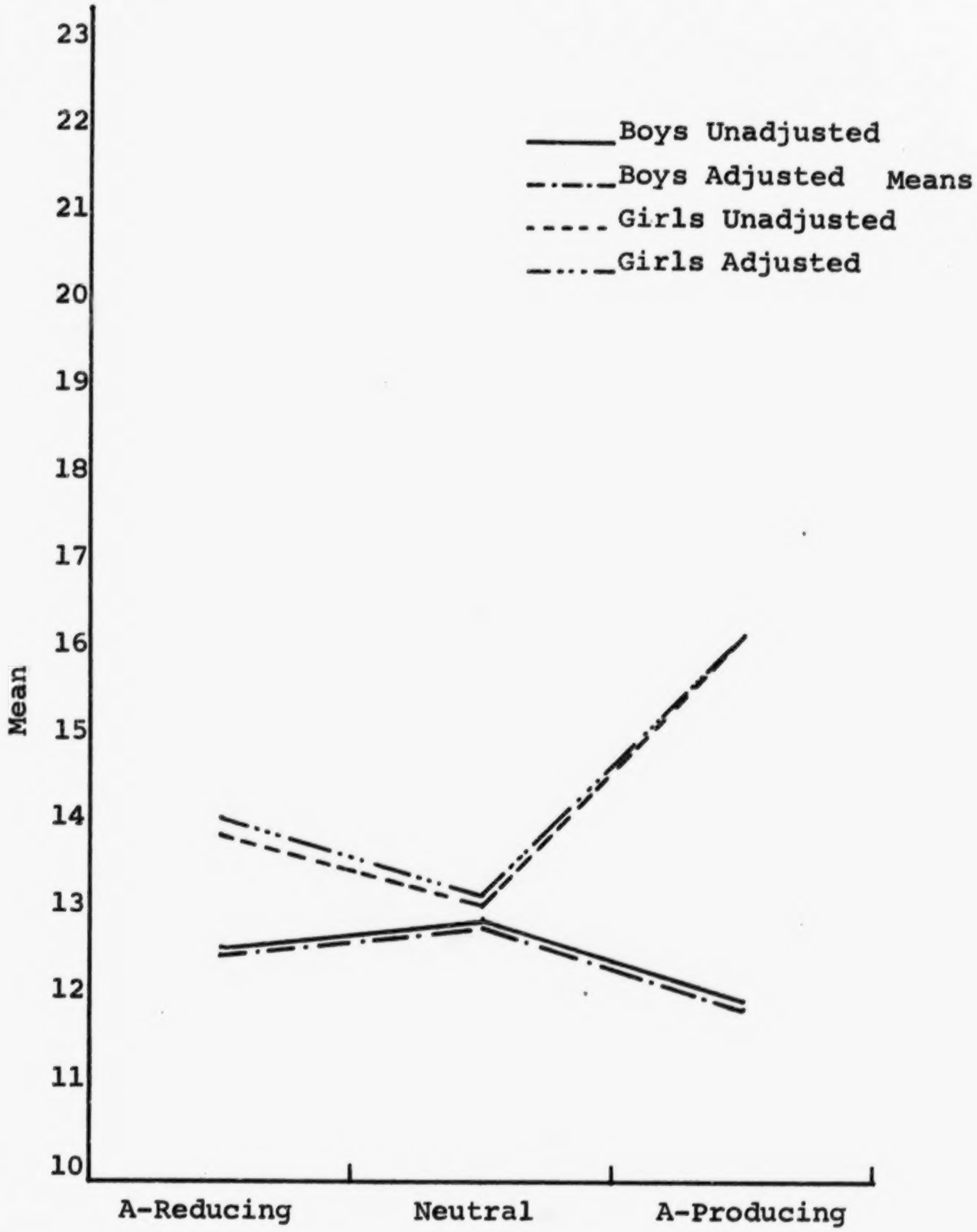


Figure 11 Unadjusted and adjusted means with the initial respiration rate held constant for the verbal scores with the three types of instructions.

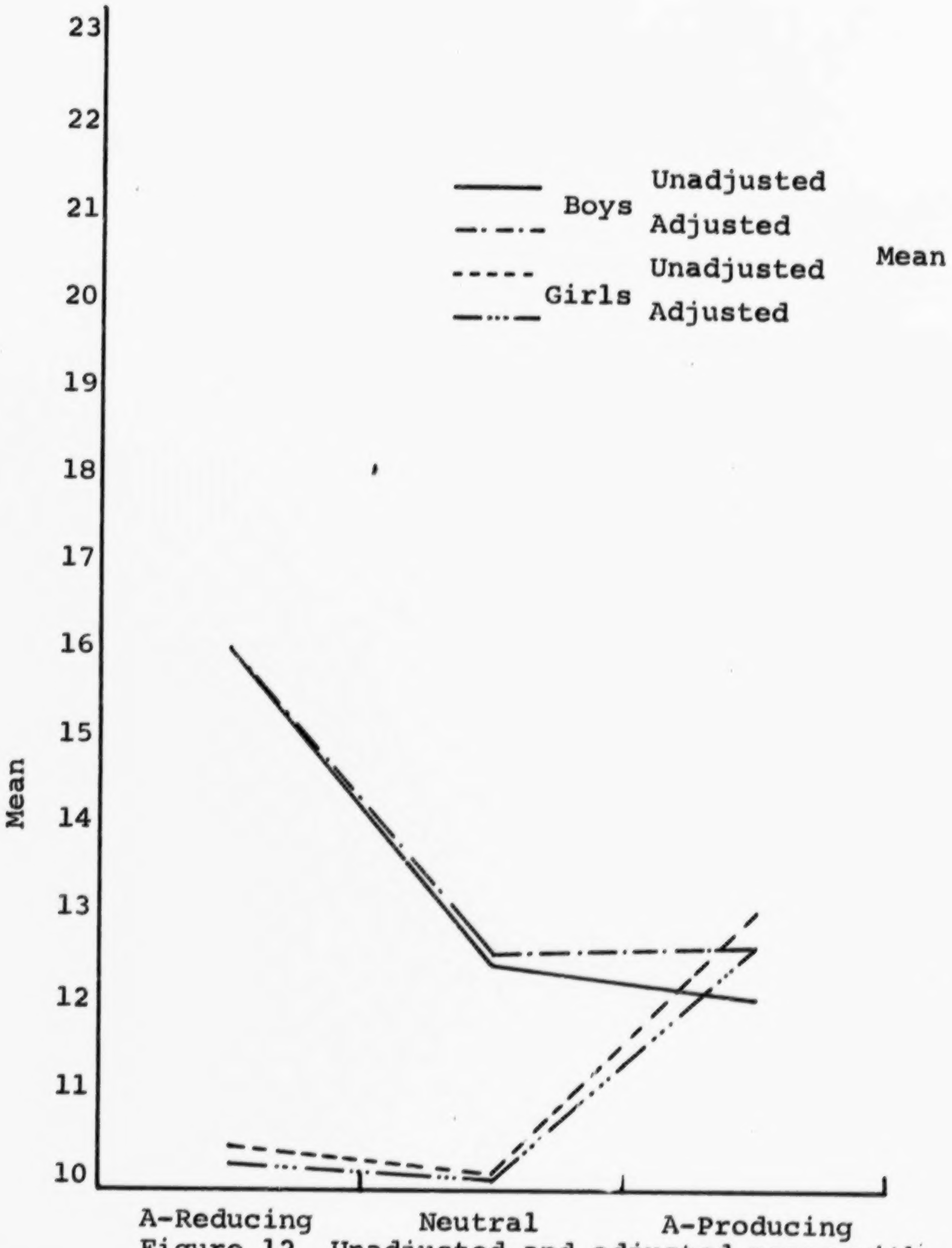


Figure 12 Unadjusted and adjusted means with the initial respiration rate held constant for the mathematical scores with the three types of instructions.

TABLE 8

Unadjusted Means and Adjusted Means with The Respiration Depth Held Constant for the Ability Test with the Three Type of Instruction

Groups	Boys Unadj. Means	 Adj. Means	Girls Unadj. Means	 Adj. Means
Total Score				
A-Reducing I	28.10	28.20	24.50	24.44
Neutral I	25.60	25.46	23.40	23.46
A-Producing I	23.70	23.74	29.50	29.51
Verbal Score				
A-Reducing I	12.70	12.76	14.00	13.96
Neutral I	13.00	12.92	13.20	13.11
A-Producing I	12.10	12.04	16.30	16.26
Mathematical Score				
A-Reducing I	16.20	16.21	10.50	10.50
Neutral I	12.60	12.59	10.20	10.46
A-Producing I	12.20	12.24	13.20	13.20

n = 20

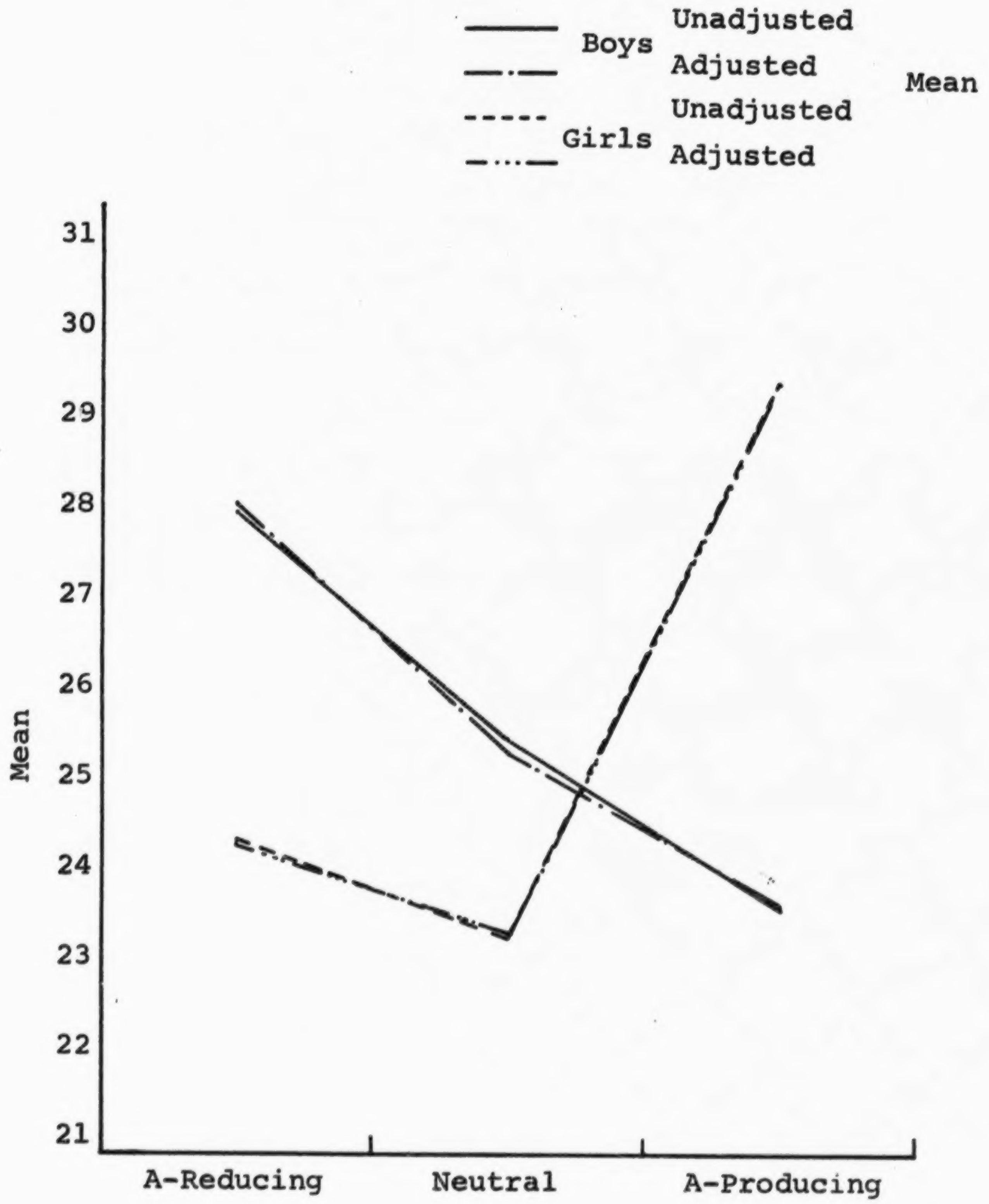


Figure 13 Unadjusted and adjusted means with the initial respiration depth held constant for the total test scores with the three types of instruction

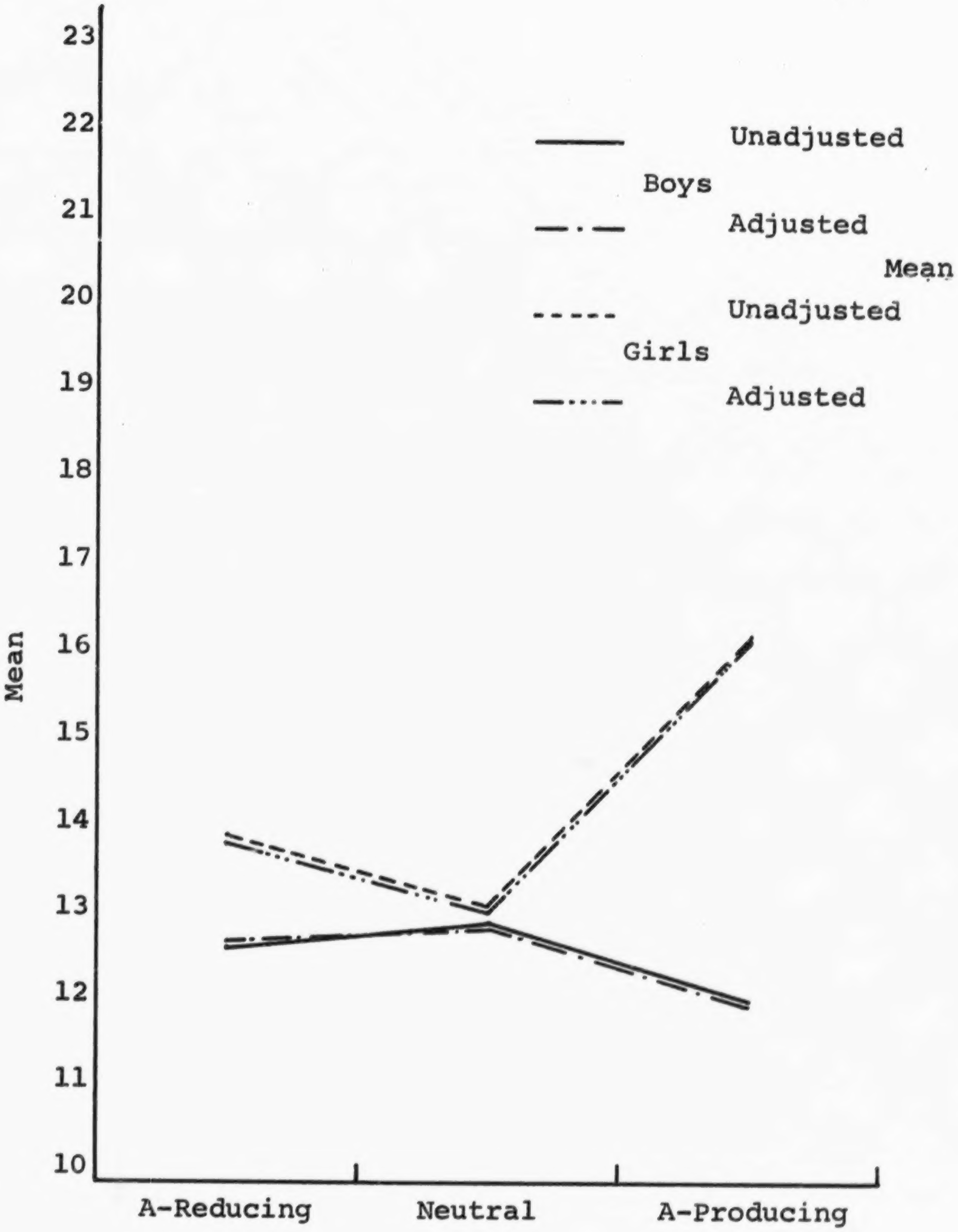


Figure 14 Unadjusted and adjusted means with the initial respiration depth held constant for the verbal scores with the three types of instruction.

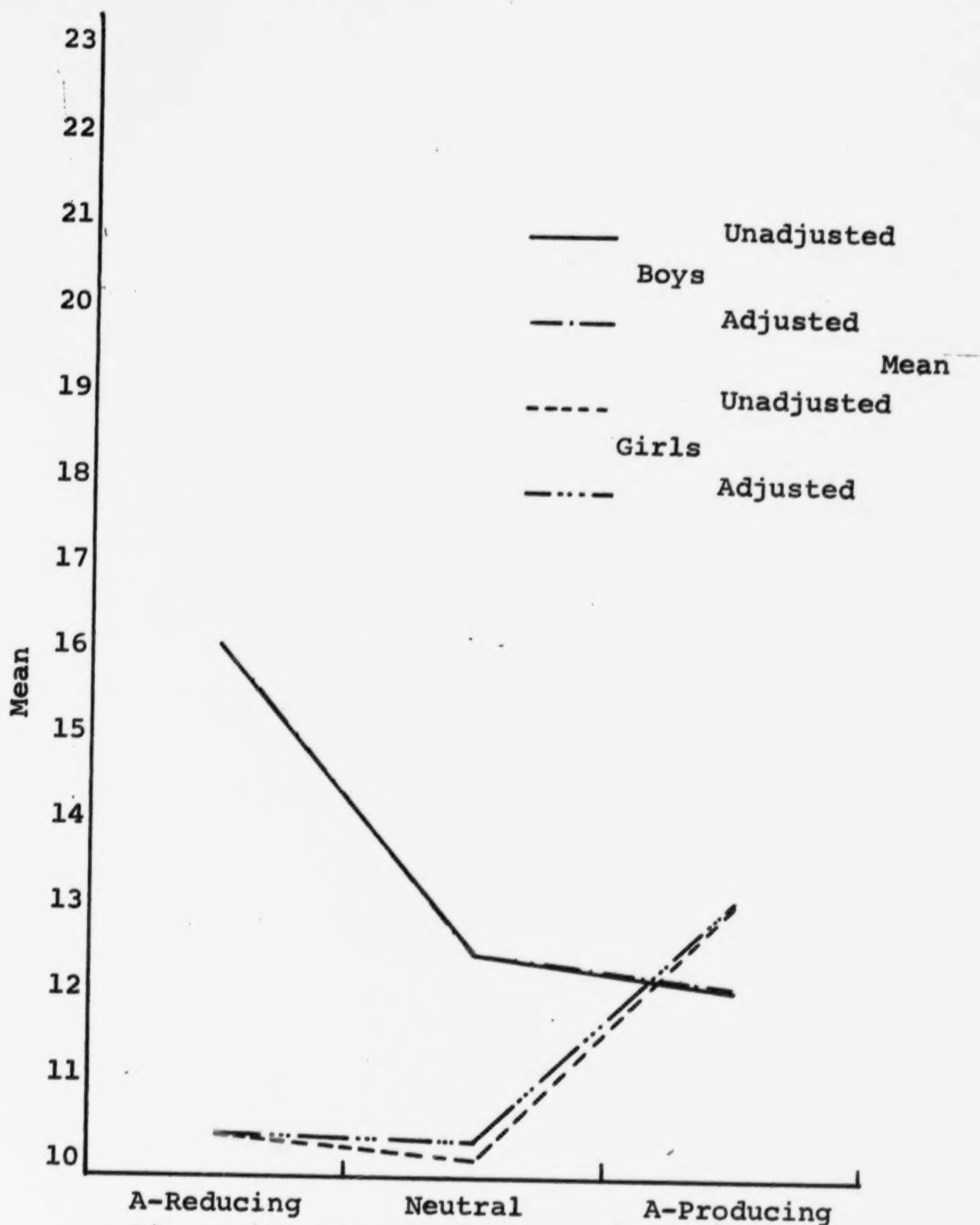


Figure 15 Unadjusted and adjusted means with the initial respiration depth held constant for the mathematical scores with the three types of instruction.

TABLE 9

Unadjusted Means and Adjusted Means with the Heart Beat Rate Held Constant for the Ability Test with the Three Type of Instruction

	Boys		Girls	
Groups	Unadj. Means	Adj. Means	Unadj. Means	Adj. Means
Total Scores				
A-Reducing I	28.10	28.11	24.50	24.71
Neutral I	25.60	25.52	23.40	23.32
A-Producing I	23.70	23.75	29.50	29.68
Verbal Scores				
A-Reducing I	12.70	12.70	14.00	13.94
Neutral I	13.00	13.02	13.20	13.56
A-Producing I	12.10	12.17	16.30	16.25
Mathematical Scores				
A-Reducing I	16.20	16.22	10.50	10.80
Neutral I	12.60	12.48	10.20	10.10
A-Producing I	12.20	11.17	13.20	13.44

n = 20

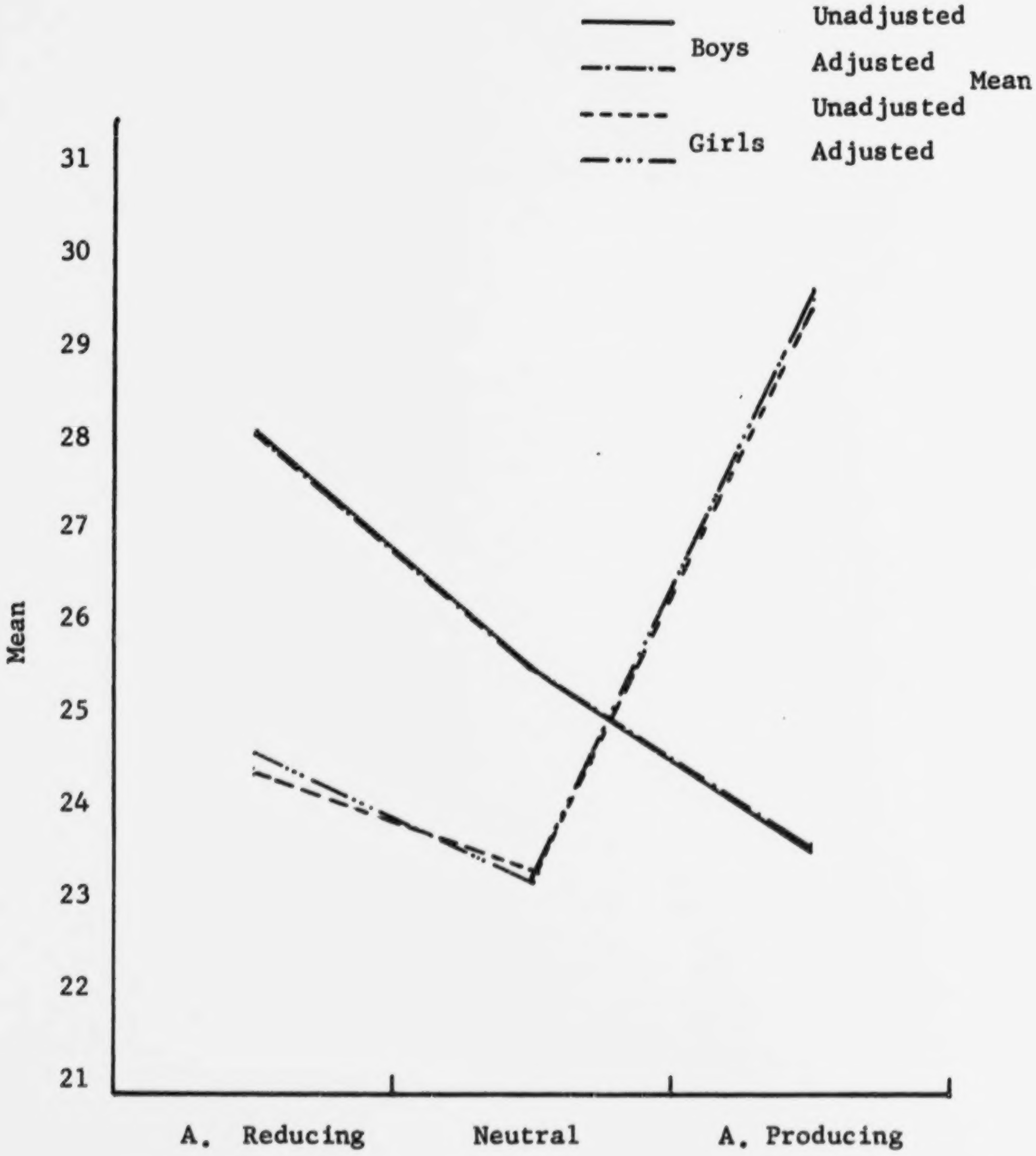


Figure 16. Unadjusted and Adjusted means with the initial heart beat rate held constant for the total test scores with the three types of instructions.

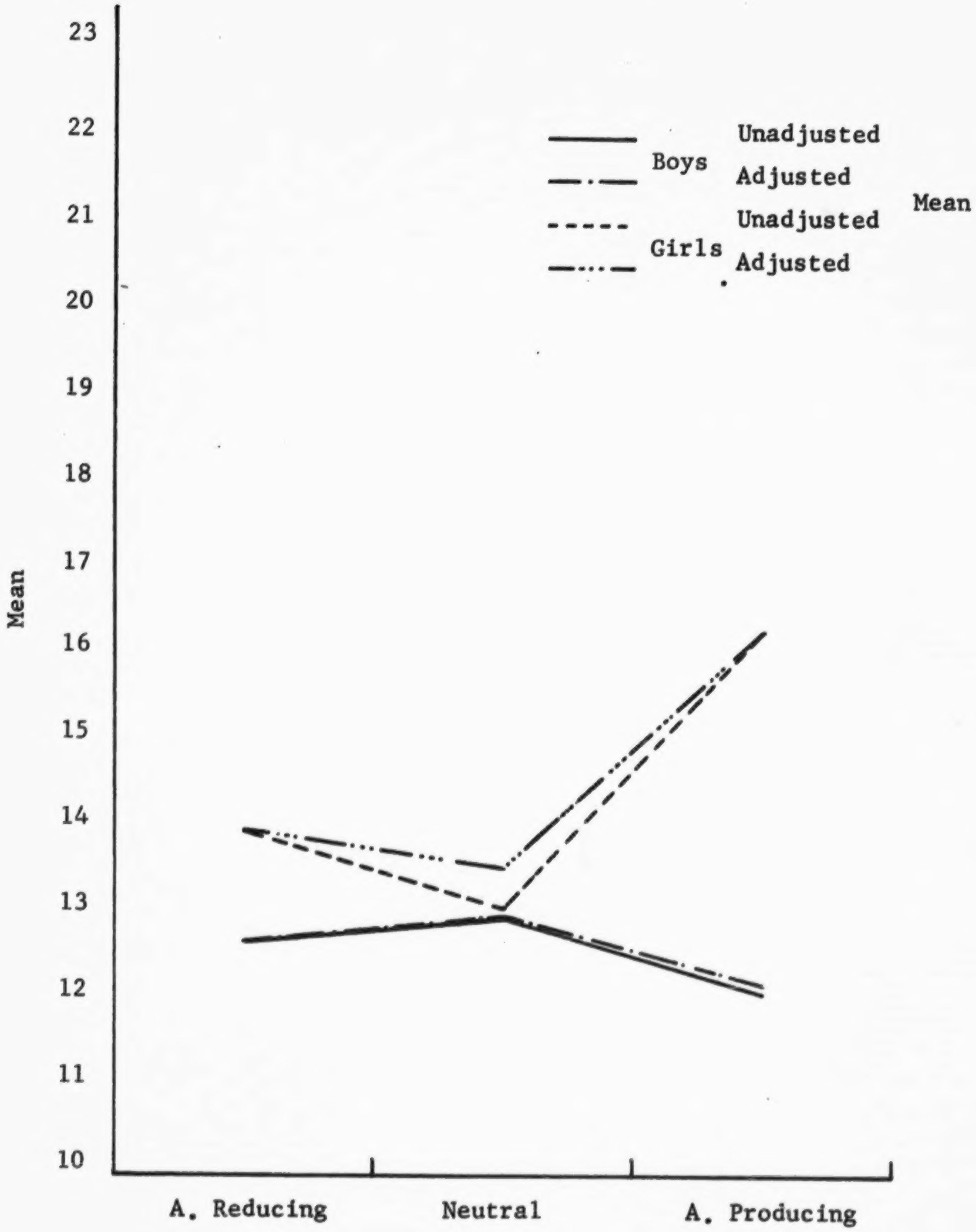


Figure 17. Unadjusted and adjusted means with the initial heart beat rate held constant for the verbal scores with the three types of instruction.

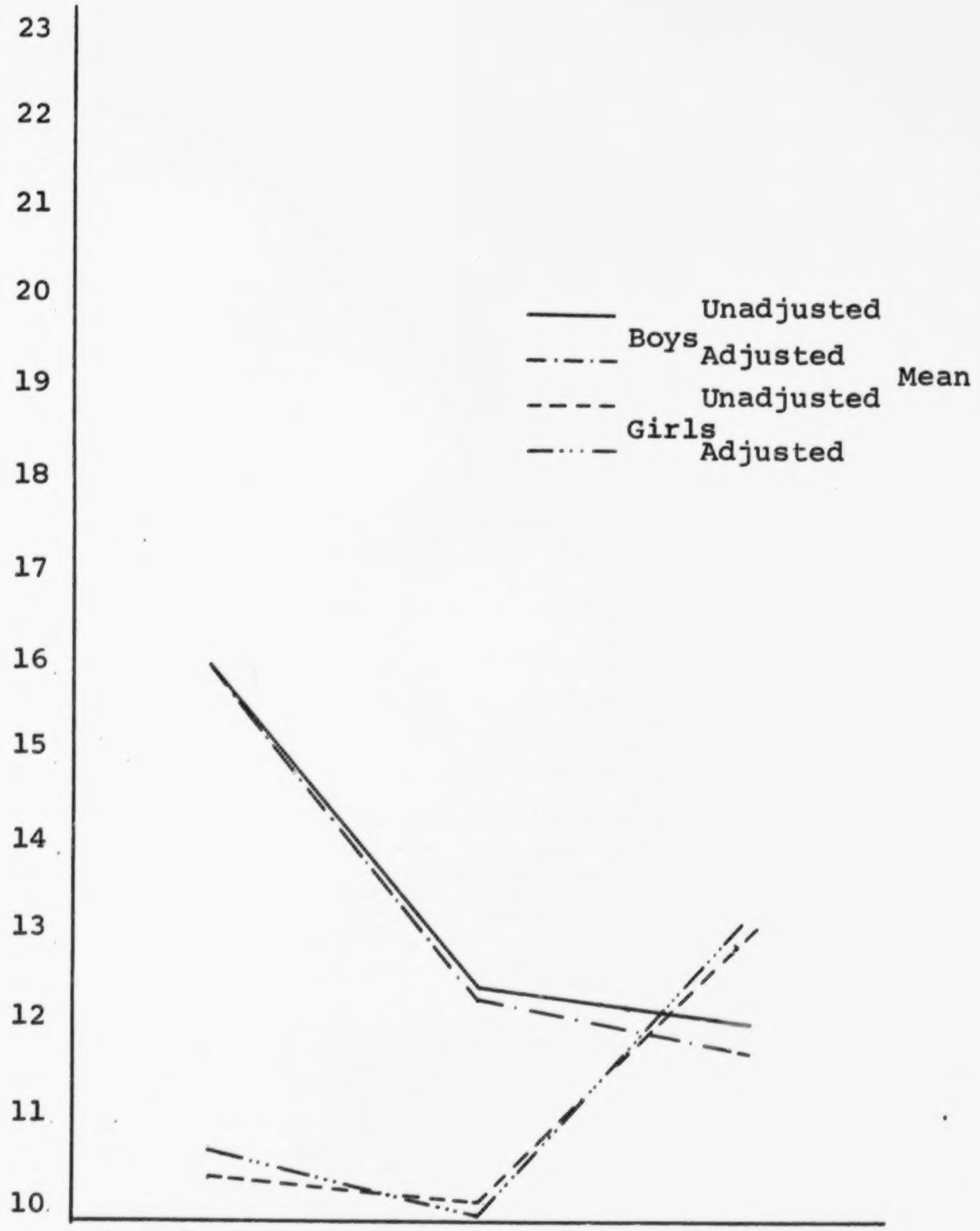


Figure 18. Adjusted and unadjusted means with the initial heart beat rate held constant for the mathematical scores with the three types of instructions.

TABLE 10

Unadjusted Means and Adjusted Means with the Diastolic Blood Pressure Held Constant for the Ability Test with the Three Types of Instruction

	Boys		Girls	
Groups	Unadj. Means	Adj. Means	Unadj. Means	Adj. Means
Total Score				
A-Reducing I	28.10	28.70	24.50	24.88
Neutral I	25.60	25.59	23.40	24.44
A-Producing I	23.70	22.73	29.50	29.02
Verbal Scores				
A-Reducing I	12.70	13.05	14.00	14.24
Neutral I	13.00	12.80	13.20	13.93
A-Producing I	12.10	11.48	16.30	16.04
Mathematical Scores				
A-Reducing I	16.20	16.43	10.50	10.66
Neutral I	12.60	12.60	10.20	10.56
A-Producing I	12.20	11.78	13.20	12.99

n = 20

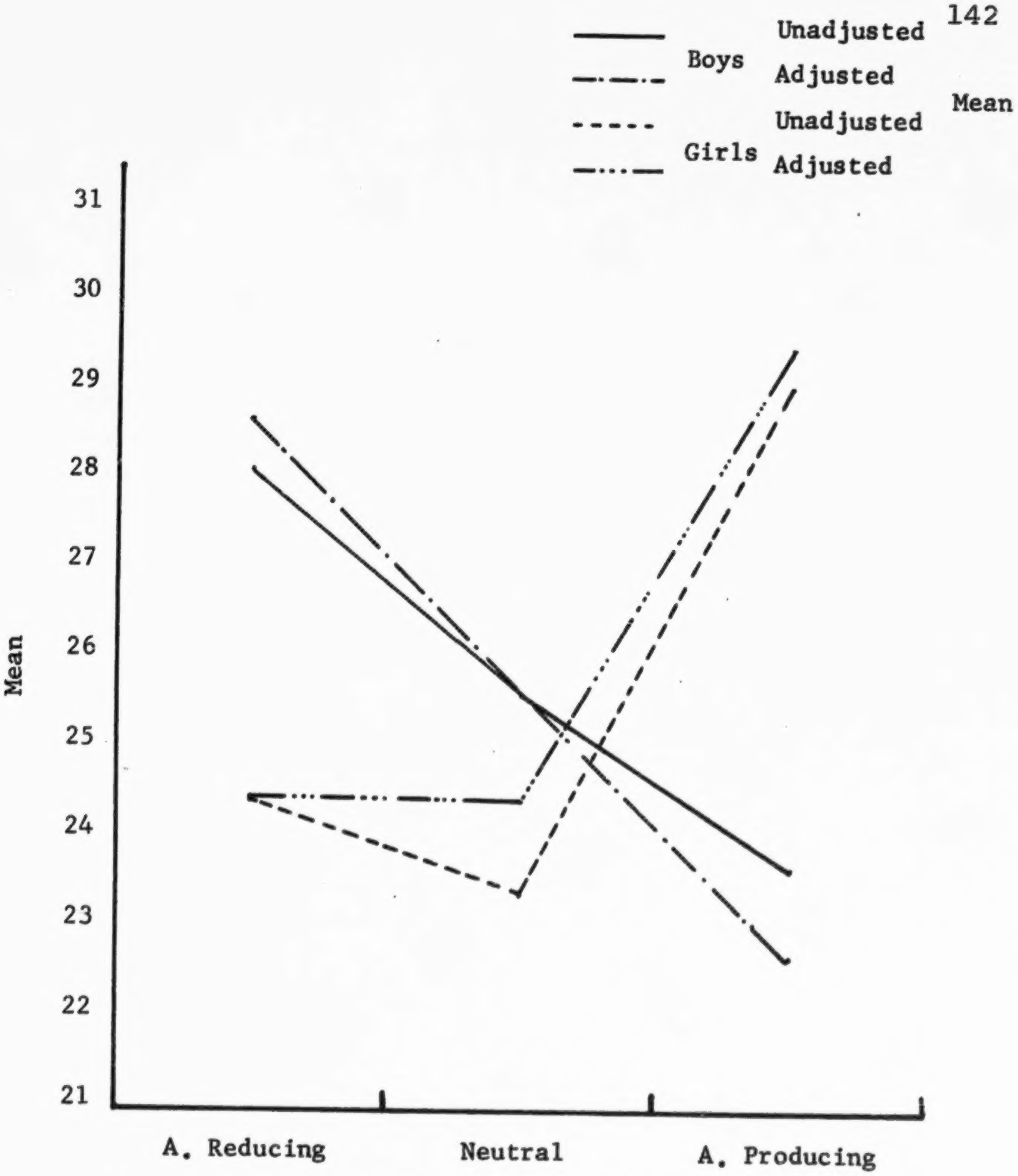


Figure 19. Unadjusted and adjusted means with the initial diostolic blood pressure held constant for the total test scores with the three types of instruction.

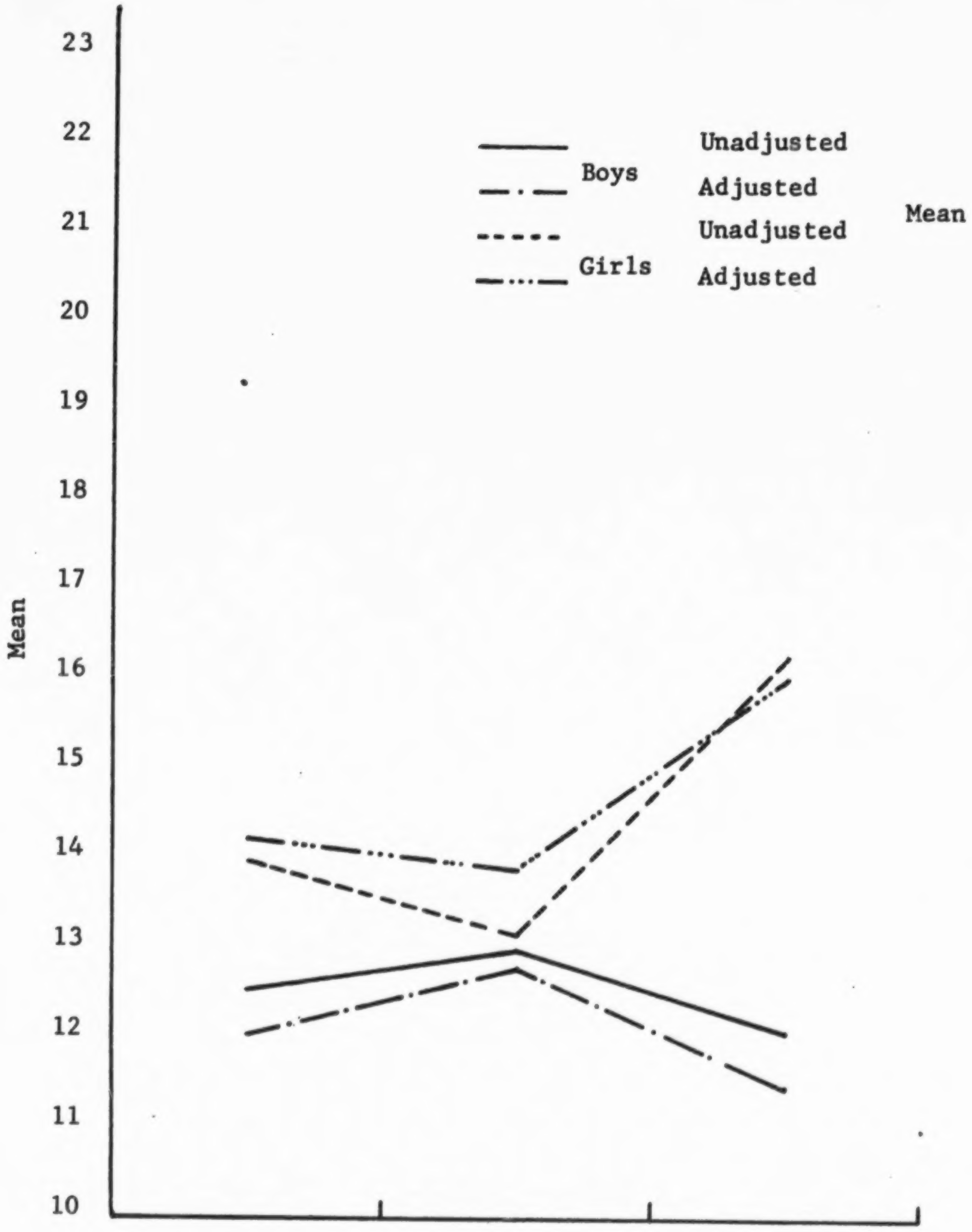


Figure 20. Unadjusted and adjusted mean with the initial diostolic blood pressure held constant for the verbal scores with the three types of instruction.

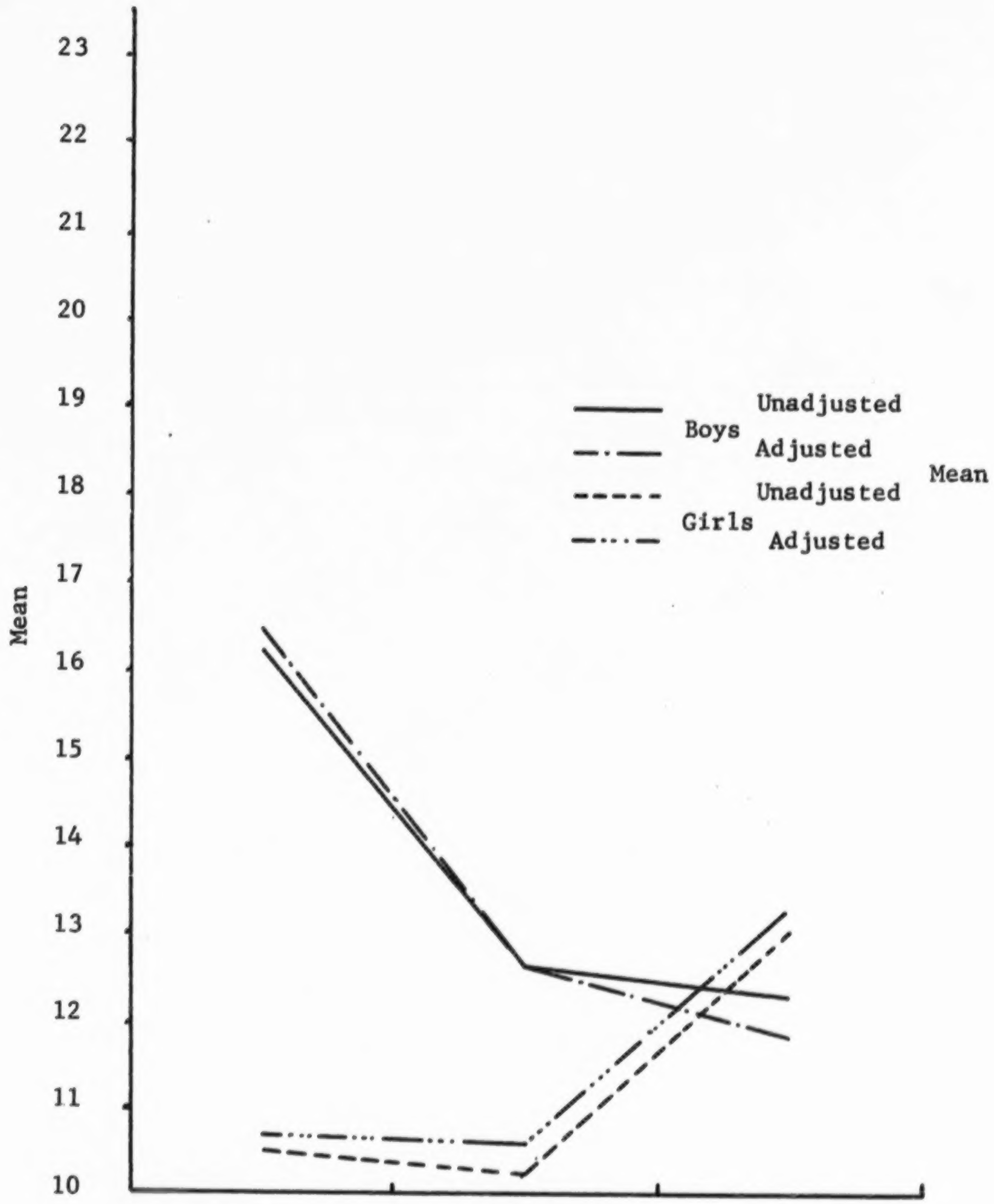


Figure 21. Unadjusted and adjusted means with the initial diastolic blood pressure held constant for the mathematical scores with the three types of instruction.

TABLE 11

Unadjusted Means and Adjusted Means with the Pulse Pressure Held Constant for the Ability Test with the Three Types of Instruction

	Boys		Girls	
Groups	Unadj. Means	Adj. Means	Unadj. Means	Adj. Means
Total Score				
A-Reducing I	28.10	27.80	24.50	25.14
Neutral I	25.60	25.88	23.40	23.90
A-Producing I	23.70	21.88	29.50	30.20
Verbal Score				
A-Reducing I	12.70	12.53	14.00	14.38
Neutral I	13.00	13.17	13.20	13.50
A-Producing I	12.10	11.01	16.30	16.72
Mathematical Scores				
A-Reducing I	16.20	16.06	10.50	10.82
Neutral I	12.60	12.74	10.20	10.44
A-Producing I	12.20	11.29	13.20	13.55

n = 20

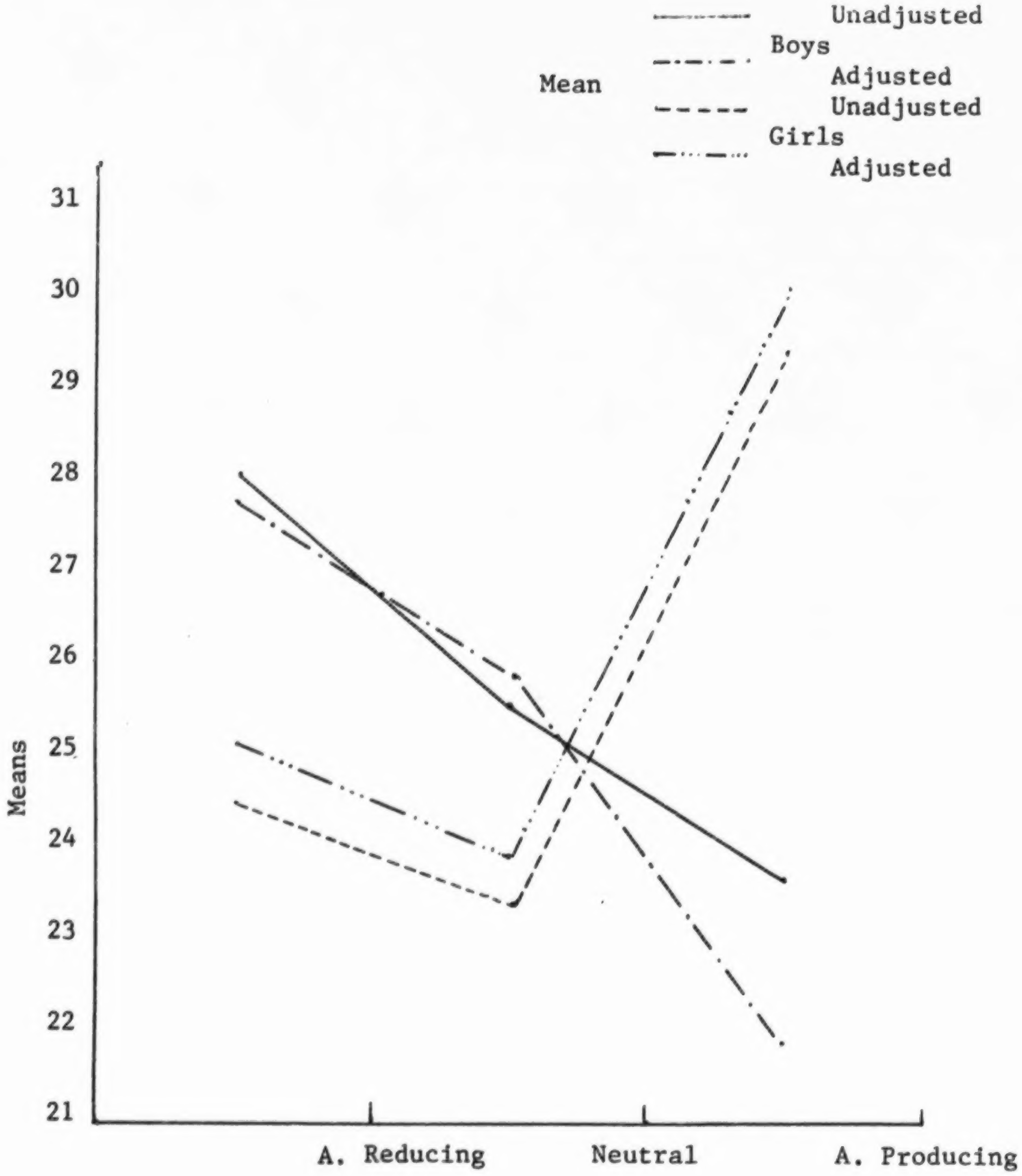


Figure 22. Adjusted and unadjusted means are the initial pulse pressure held constant for the total test scores with the three types of instructions.

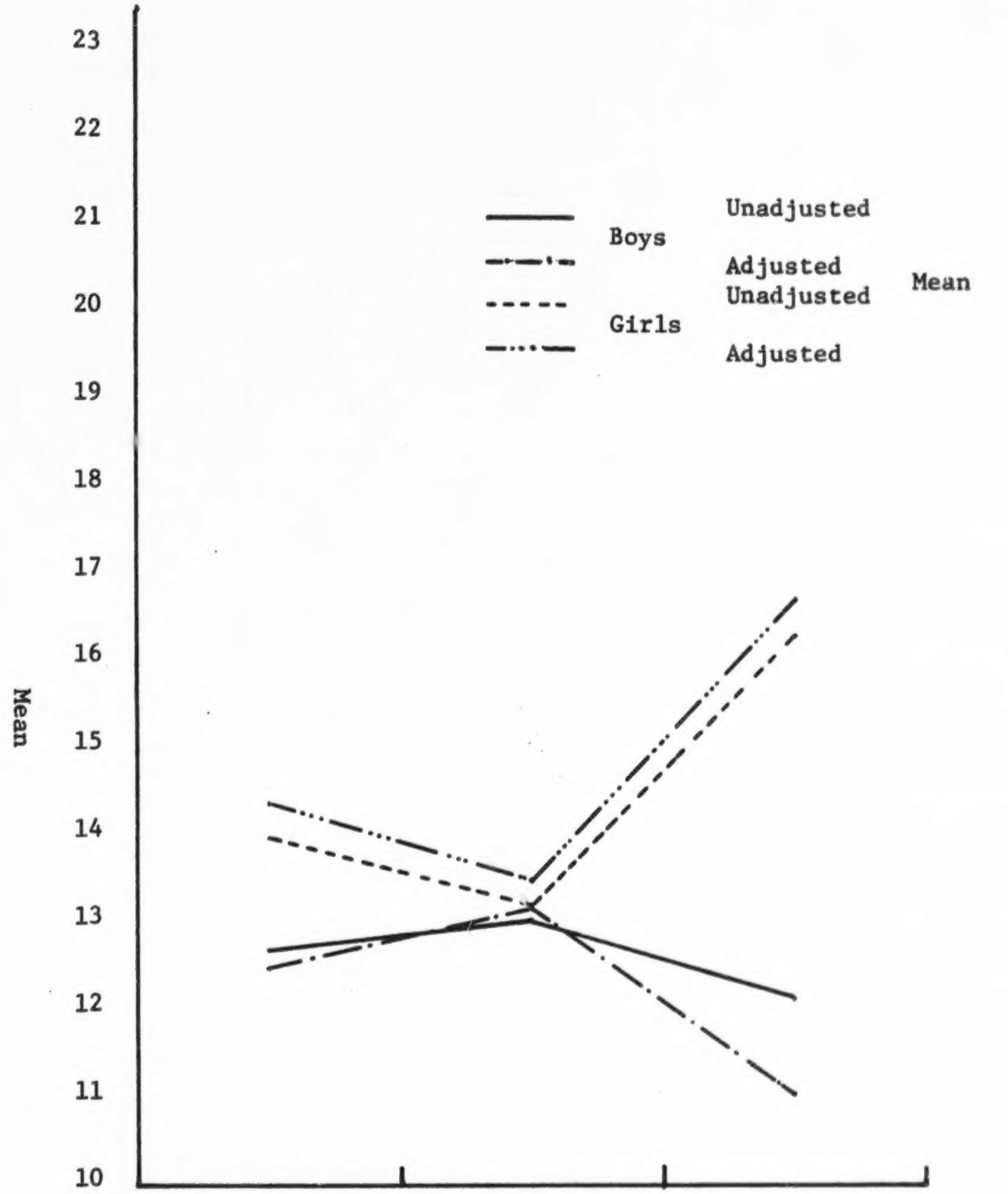


Figure 23. Unadjusted and adjusted means with the initial Respiration depth held constant for the verbal scores with the three types of instruction

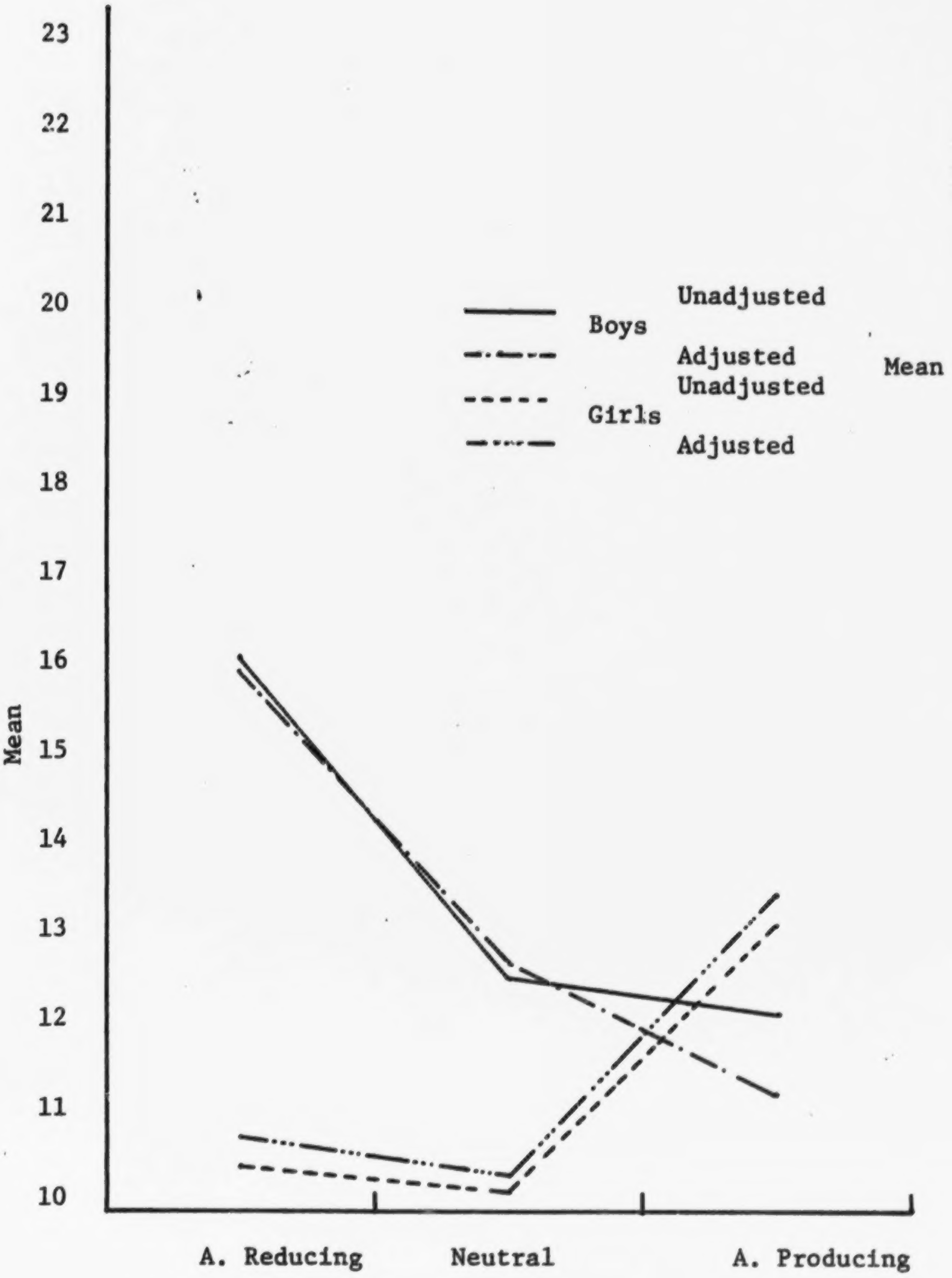


Figure 24. Unadjusted and adjusted means with the initial respiration rate held constant for the mathematical scores with the three types of instructions.

Results and Discussion

The only physiological measure that provided a significant difference between the treatment instructions was respiration rate, significant at the .01 level of confidence. However, the order of responding was the reverse for both sexes to that hypothesized (observe Tables 112-123 and Figures 25-34).

The respiration rate was the highest for the anxiety-reducing instructions for both sexes, with the girls breathing more rapidly than the boys. Under the influence of neutral instructions, both sexes obtained a medium respiratory rate, as was hypothesized, and the lowest level of responding was for the treatment group with anxiety-producing instructions. For the control, the girls' rate was even lower than it was with the anxiety-producing instructions.

The fastest respiration rate for both sexes was with anxiety-reducing instructions. Cannon (1929, p. 211) found that animals, during emotional excitement, tend to experience deep and rapid respiration. Therefore, it was expected that students with anxiety-reducing instructions would experience a slower respiration rate. The reverse, then, would be true for anxiety-producing instructions. However, a major difference that persists between an animal and a

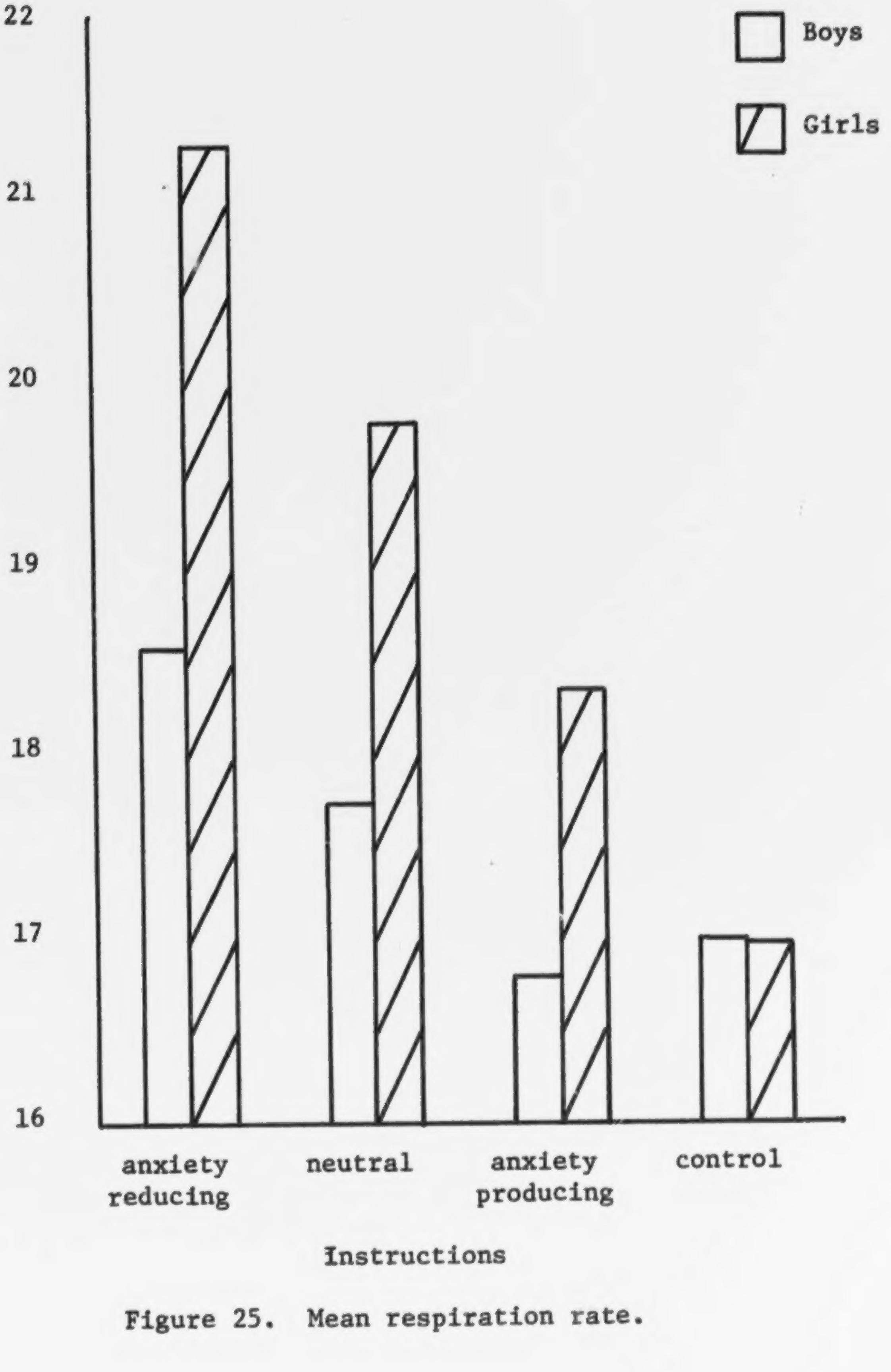


Figure 25. Mean respiration rate.

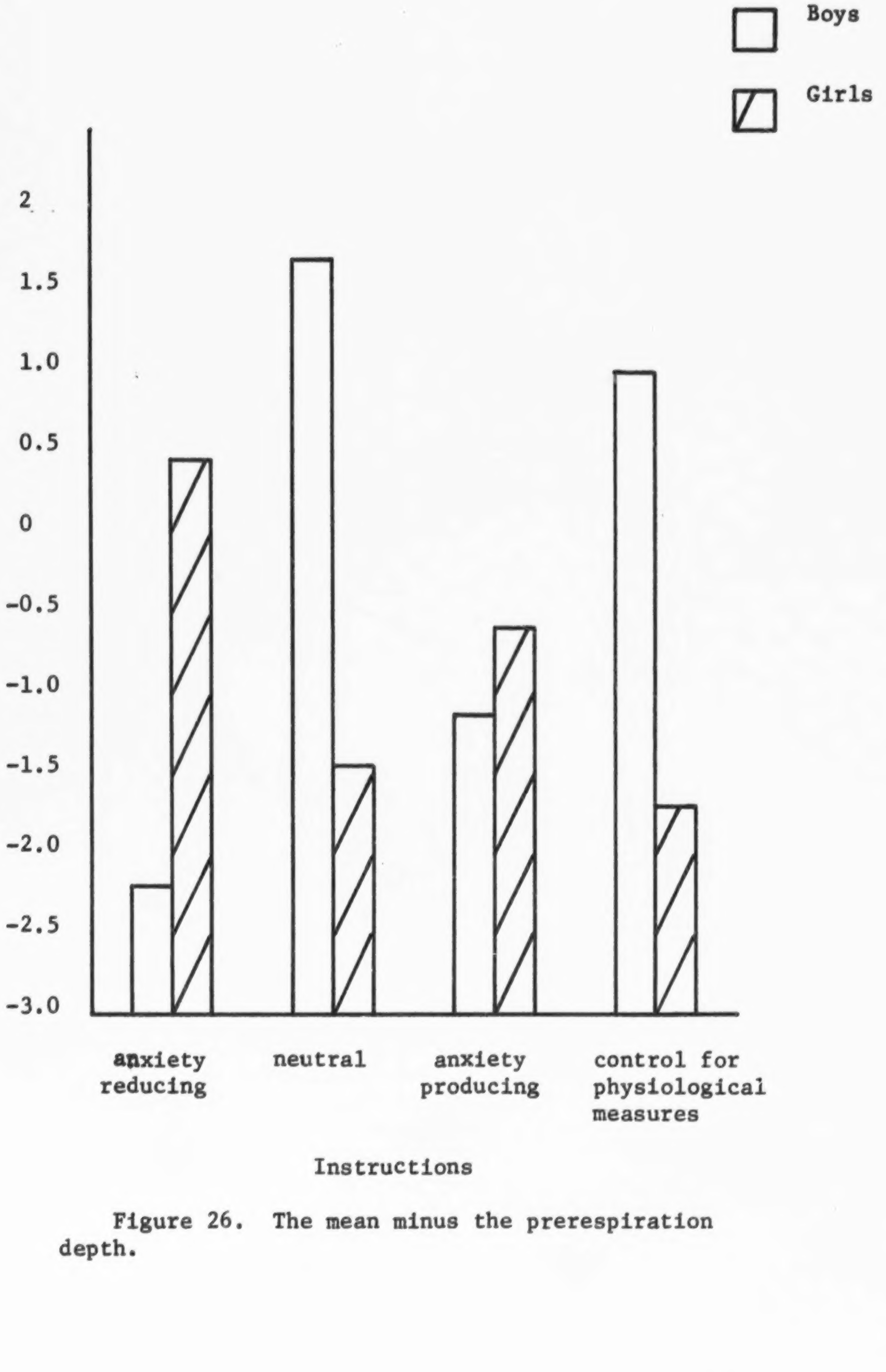


Figure 26. The mean minus the prerespiration depth.

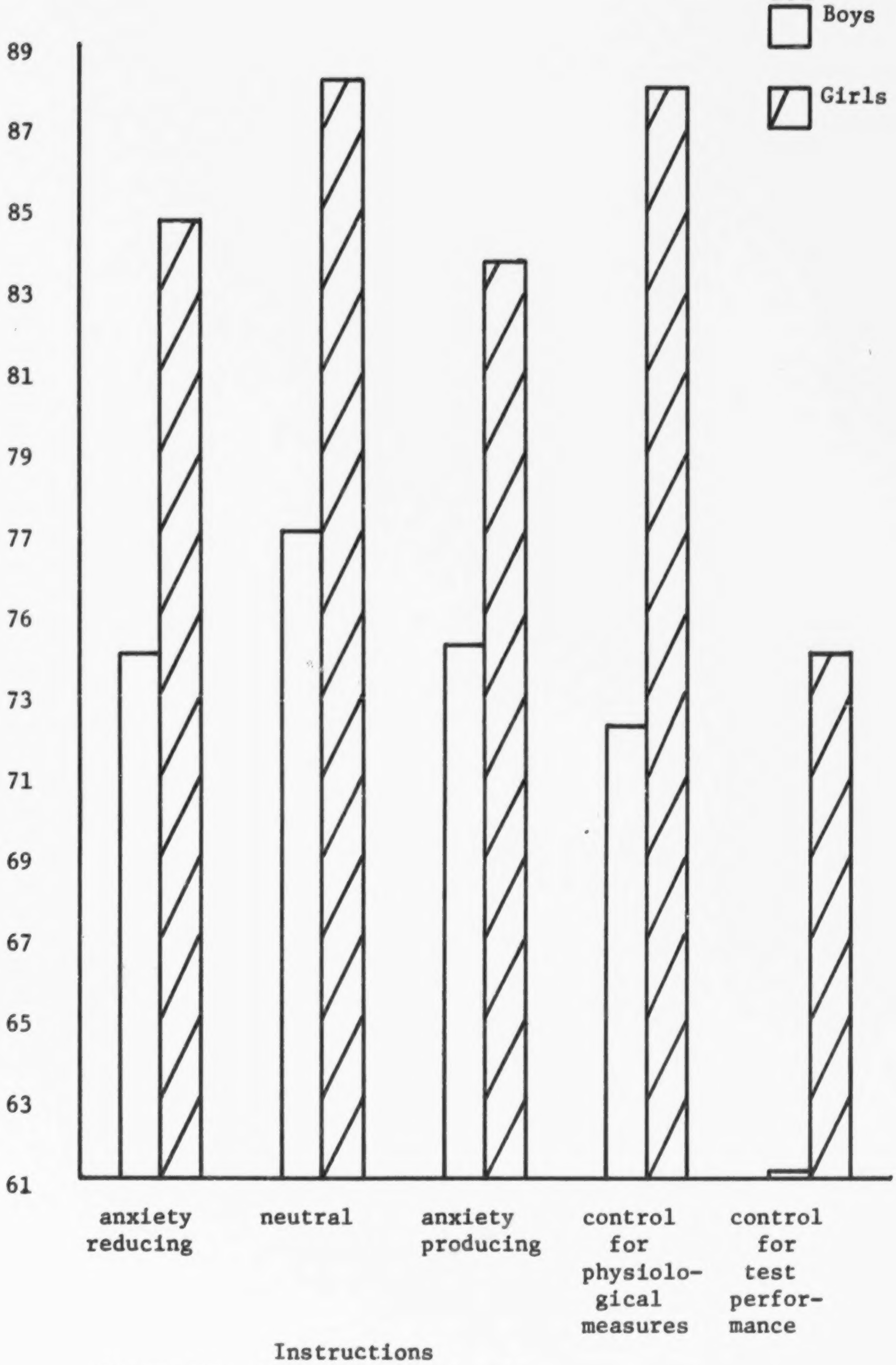


Figure 27. Mean heart beat rate.

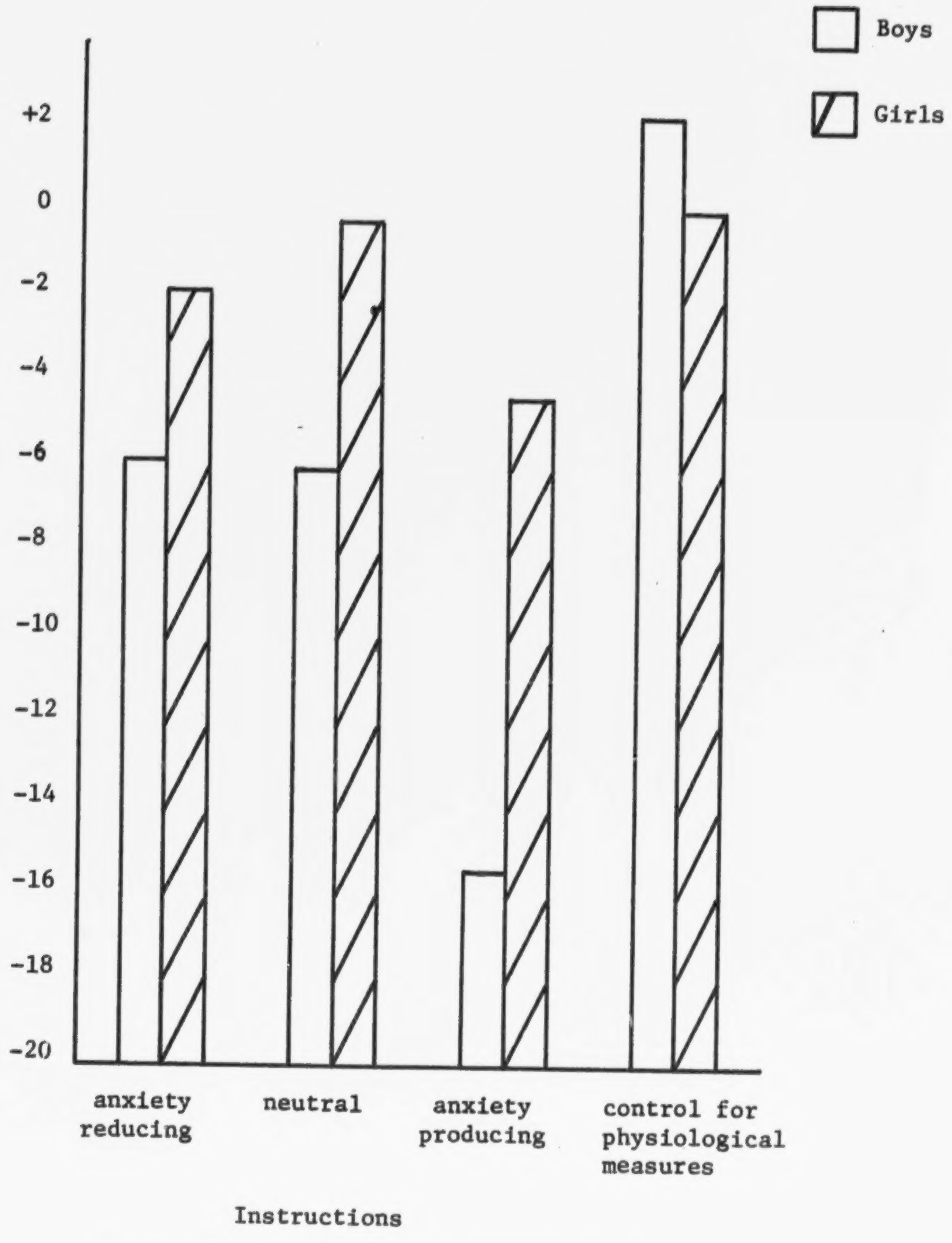


Figure 28. Mean minus the prereading for Galvanic Skin Response.

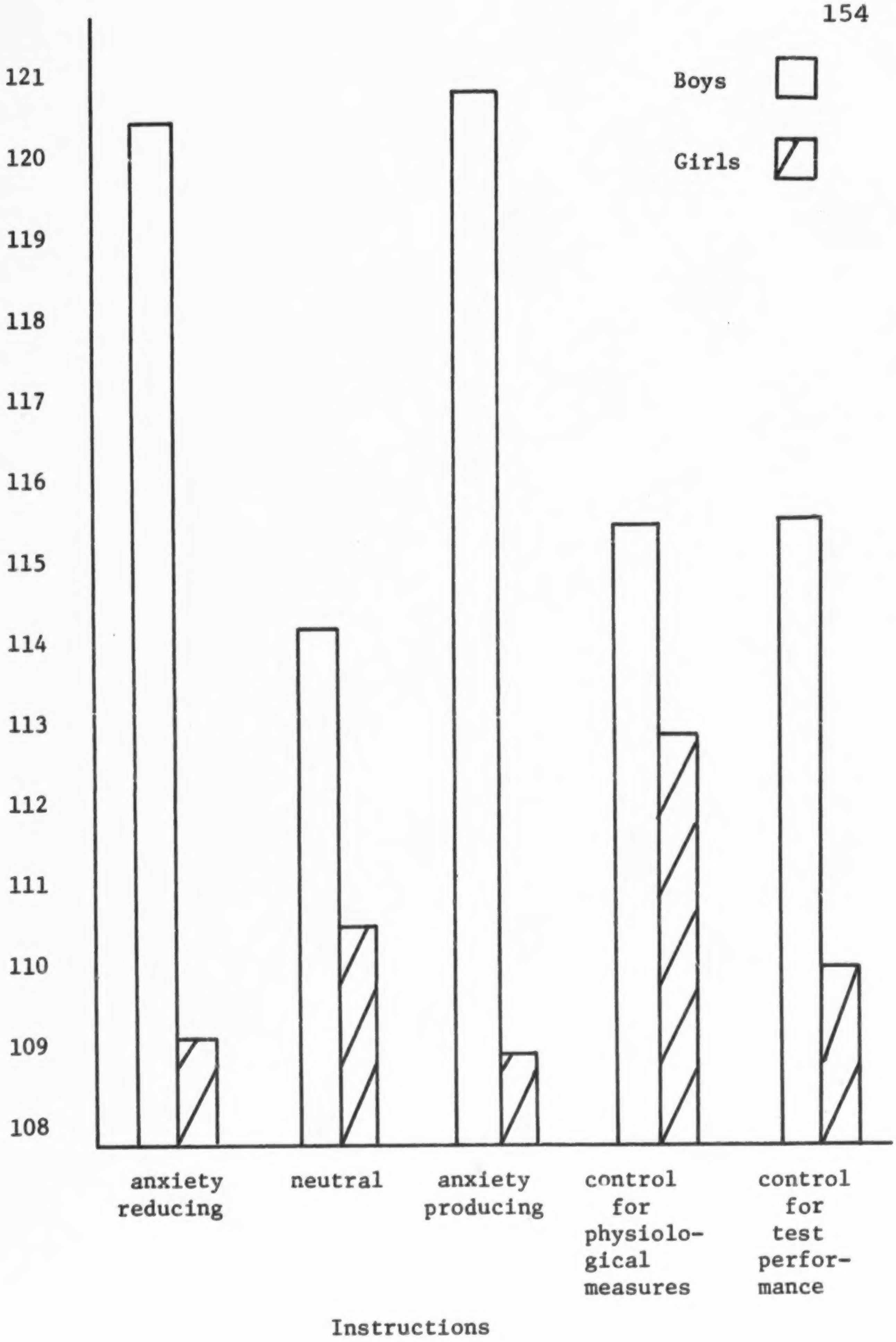


Figure 29. Mean systolic blood pressure.

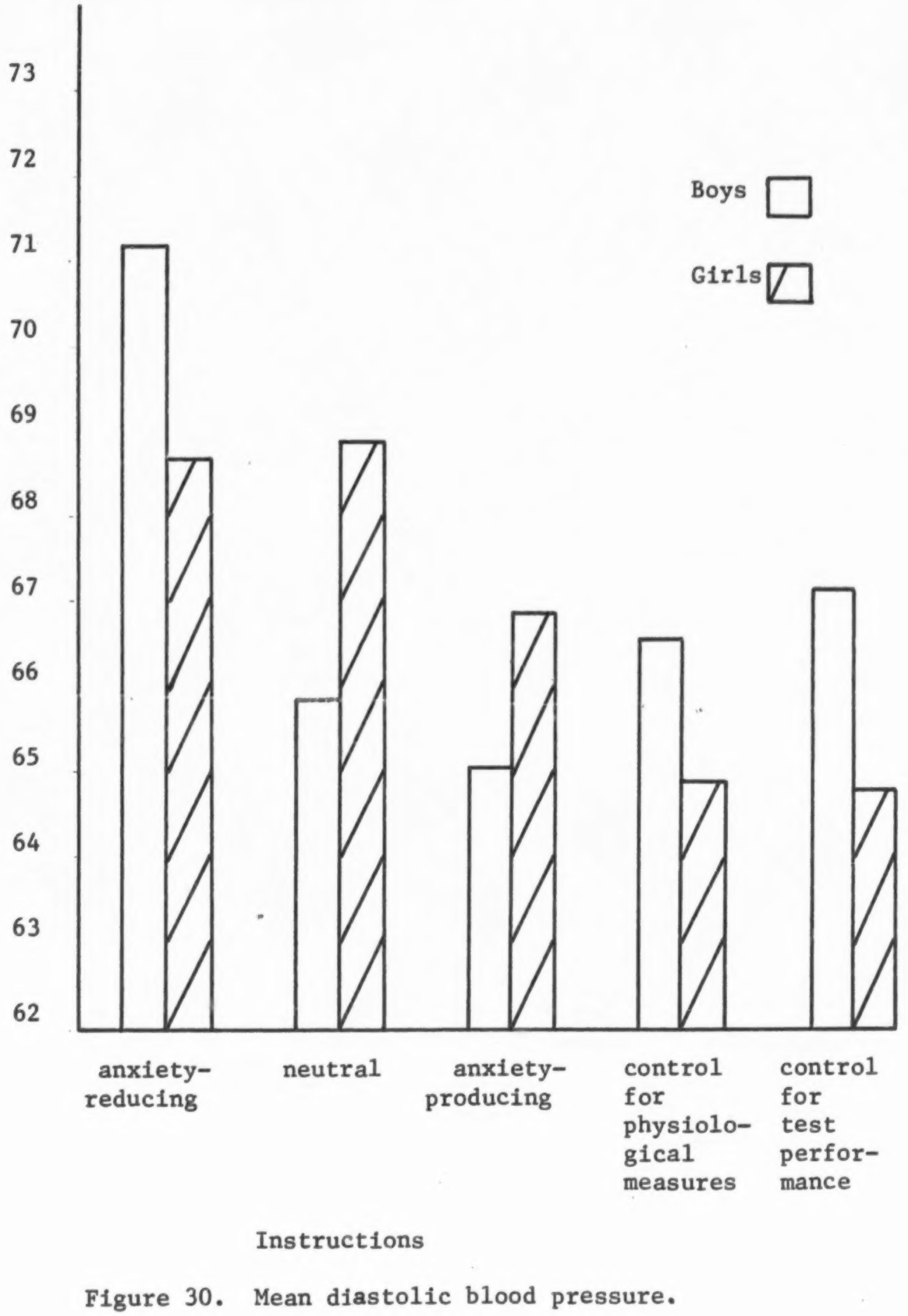


Figure 30. Mean diastolic blood pressure.

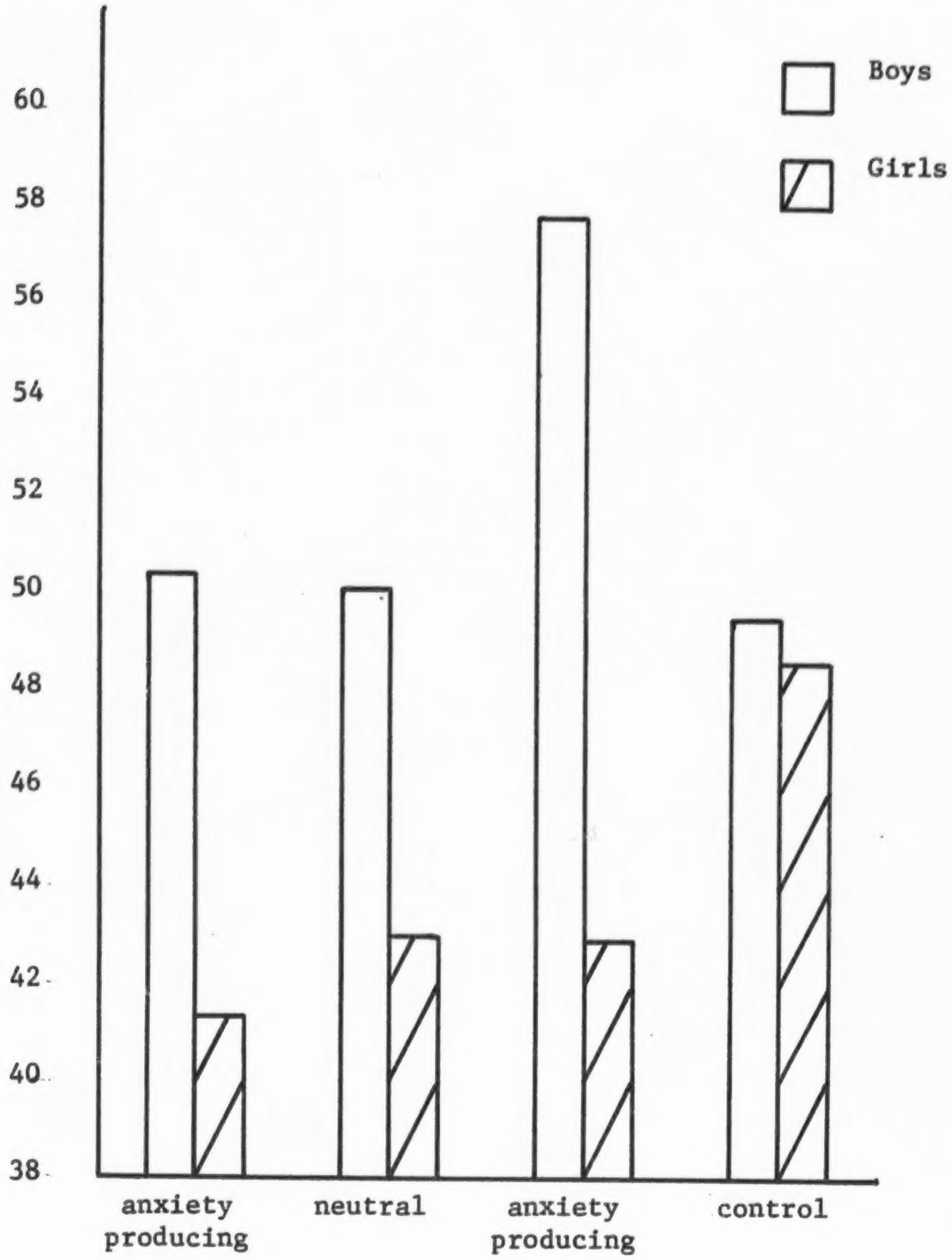


Figure 31. Mean pulse pressure.

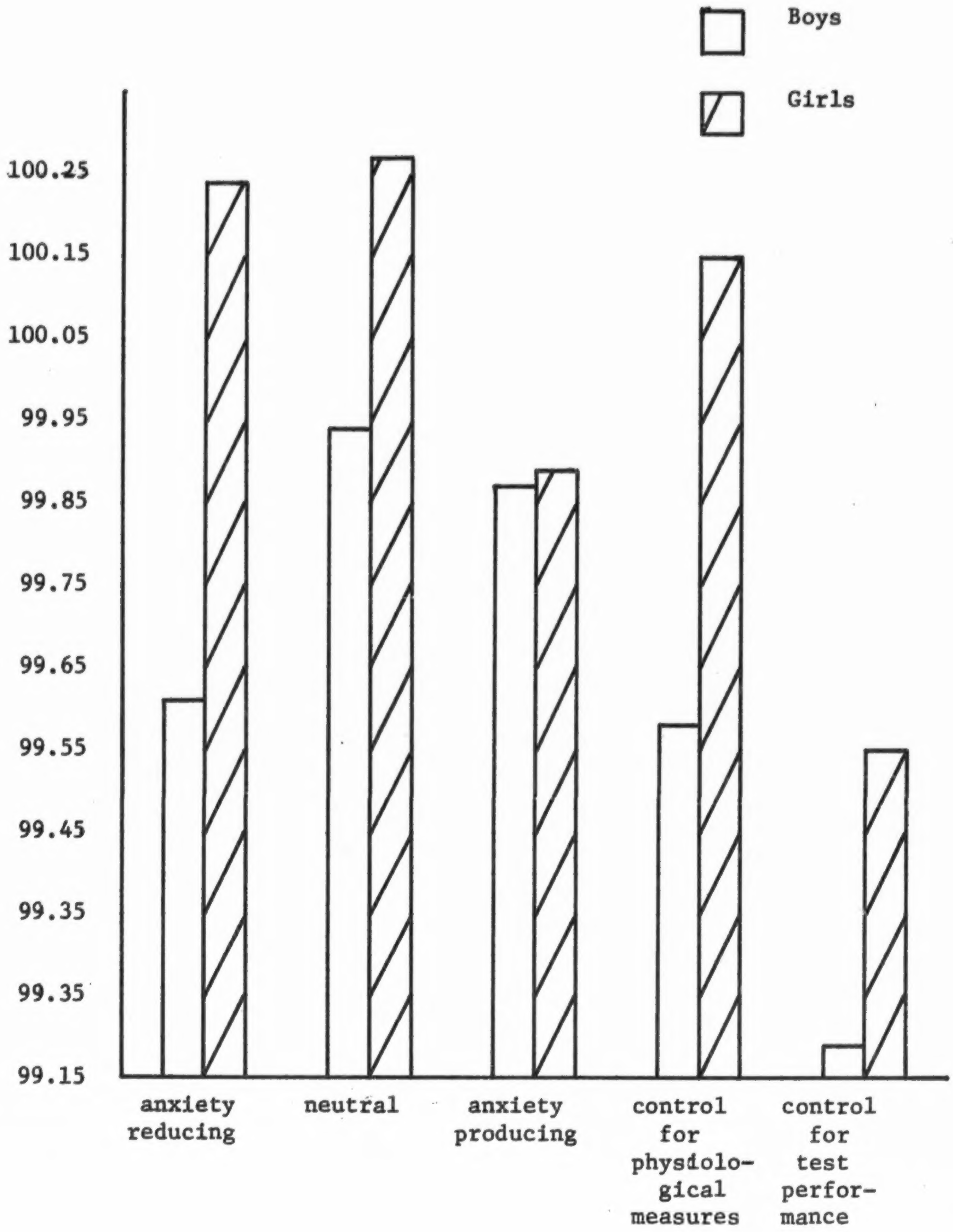


Figure 32. Mean oral temperature.

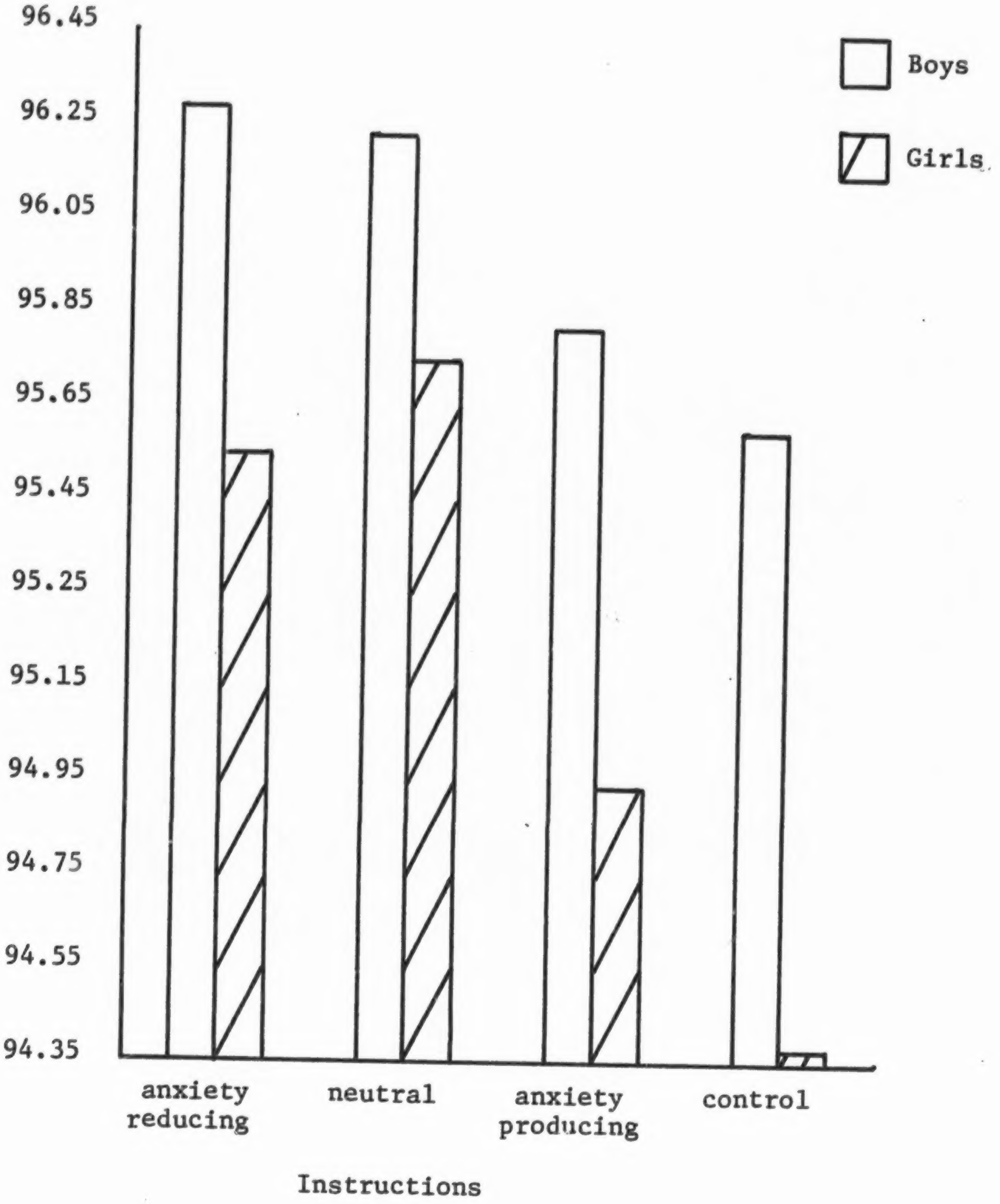


Figure 33. Mean face temperature.

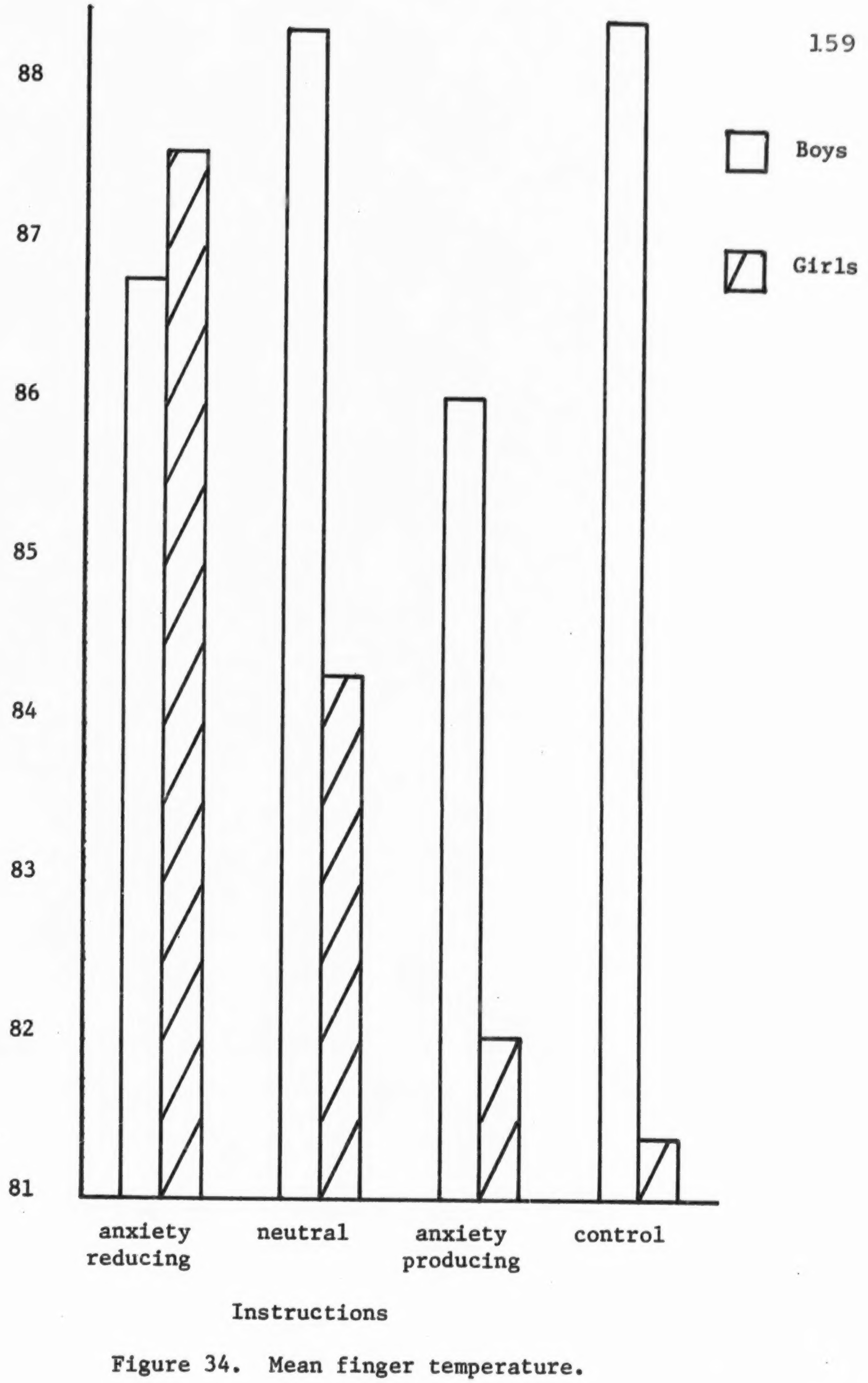


Figure 34. Mean finger temperature.

student taking an examination is the degree of activated motor response during excitement experienced by the animal, which is not present in the case of the student. The motor activity per se may tend to accelerate the respiration of the animal. Even so, this is not the complete answer. Best and Taylor (1961, pp. 1024, 1025) point out that both adrenaline and noradrenaline, after a short initial period of apnea, causes respiration to increase in rate and depth. According to Best and Taylor, these two secretions are activated by sympathetic fibers. Ax (1953), Schachter (1957), and others have shown the sympathetic nervous system to be extensively involved during anxiety. Therefore, if a student performs with anxiety-producing instructions, it seems that the respiration rate would be accelerated. Brown and Van Gelder (1938) did not use experimental instructions, but they did find respiratory rate to be greatest with the most difficult examination.

Clemens (1957) gave subcutaneous injections of epinephrine and found increases in the initial respiration period but decreases in respiration period during later time intervals (increased respiration period may be slower rate). This may not answer the problem but at least there are two effects that could be expected.

Perhaps the treatment instructions interacted with the experimental testing situation to obstruct more significance than was evidenced.

Hypothesis Four

There will be no difference in physiological responding between high and low proficiency levels.

Results and Discussion

Hypothesis Six was confirmed. There were no significant differences in the physiological responses of the students with high and low proficiency levels. (Observe Tables 112-123 in Appendix B).

The F values for physiological responses and proficiency levels were very low. All the values were less than one, except systolic blood pressure, diastolic blood pressure, and oral temperature. The findings under the conditions of this study indicate no significant relationship between physiological responses and proficiency levels.

Hypothesis Five

Boys will have higher physiological measures than girls for face temperature, finger temperature, systolic blood pressure, diastolic blood pressure, and pulse pressure. Girls will have higher measures than boys for oral temperature, respiration rate, respiration depth, heart beat rate, and GSR.

Results and Discussion

The results are presented in Table 12 and in Tables 112-123 in Appendix B. The hypothesis that the boys would have higher face and finger temperatures than the girls was confirmed. The differences for both measures were significant at less than the .05 level of confidence. The means for the face and finger temperatures are presented in Tables 13 and 14. However, high scores do not always indicate a higher level of anxiety experienced.

Finger and face temperatures have not been investigated extensively, although a few studies have used it. A drop in finger temperature was observed by Clemens (1957) after a subcutaneous injection of USP epinephrine. According to Best and Taylor (1961, p. 1025) adrenaline constricts the capillaries of the skin. If there is an increased secretion of adrenaline during anxiety, and if it causes constriction of the capillaries of the skin, one might expect less blood in the surface of the skin, which would cause a lower skin temperature. Stevens (1951, p. 477) corroborates this line of thought. He says emotional stress is reported to produce a fall

TABLE 12

Summary of Results for Means and Analysis of Variance for Sex Differences for Physiological Measures

Measures	Means		F	Higher Means
	Boys	Girls		
Face Temp.,[a] F°	95.98	95.15	6.12*	Boys
Finger Temp.[a] F°	87.42	83.86	4.96*	Boys
Systolic BP[b], mm. Hg.	117.54	110.48	12.43**	Boys
Pulse Pressure[b] mm. Hg.	51.92	43.95	12.10**	Boys
Resp. Rate, per min.	17.55	19.05	4.81*	Girls
Oral Temp, F°	99.64	99.99	18.23**	Girls
GSR, microhms[a]	79.58	78.92	1.43	neither
Resp. Depth, Resp. Cycles, per min.[a]	25.44	22.32	.09	neither
EKG, per min.	71.72	83.74	.02	neither
Diastolic BP, mm. Hg.	67.20	66.85	.03	neither

*Significant at .05 Level

**Significant at .01 Level

[a] Higher scores may indicate less anxiety (Stevens, 1951, p. 477).

[b] Boys systolic blood pressure 4 or 5 mm. above girls. This may influence pulse pressure also.

TABLE 13

Means and Standard Deviations for Face Temperature

Instruction Groups	Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	Total Mean	Total S.D.
Anxiety-Reducing	96.27	0.87	95.53	1.42	95.90	1.14
Neutral	96.23	1.18	95.75	1.27	95.99	1.22
Anxiety-Producing	95.82	1.44	94.94	1.67	95.38	1.56
Total	96.10	1.16	95.41	1.45	95.76	1.31
Control for Physiological Measures	95.59	1.01	94.38	1.99	94.98	1.50
Total	95.98	1.12	95.15	1.59	95.56	1.36

n = 20

TABLE 14

Means and Standard Deviations for Finger Temperature

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	86.84	8.67	87.72	5.42	87.78	7.04
Neutral	88.37	6.90	84.30	5.81	86.34	6.36
Anxiety-Producing	86.06	8.41	82.04	3.93	84.05	6.17
Total	87.09	7.99	84.69	5.05	86.06	6.53
Control for Physiological Measures	88.42	7.89	81.37	6.34	84.90	7.12
Total	87.42	7.97	83.86	5.38	85.77	6.67

n = 20

in skin temperature. "Conflict is associated with vasoconstriction and a fall in temperature, whereas uninhibited action and emotional security are said to result in vasodilatation and a rising skin temperature."

Physiological measures are difficult to interpret. As previously shown, there is a suggestion of lower finger temperature accompanying increased anxiety. The girls' lower face and finger temperatures may indicate greater anxiety.

The hypothesis that the boys would have higher measures for systolic blood pressure and pulse pressure was confirmed. These differences were significant at less than the .01 level of confidence (observe Table 12). The means for the systolic blood pressure and pulse pressure are set forth in Tables 15 and 16.

Smith and Wenger (1965) found a mean of 126.05 for the systolic blood pressure during the examination and 116.23 for the comparative reading. The differences were significant at less than the .01 level. These measurements are only slightly higher than that of the present study, 115.10 for the anxiety-producing instruction group. Brown and Van Gelder (1938) did not present their measures in absolute scores, but they did find an increase of 15.11 before an important examination. Best

TABLE 15

Means and Standard Deviations for Systolic Blood Pressure

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	120.70	7.64	109.30	10.50	115.00	9.07
Neutral	114.40	10.81	110.70	8.74	112.55	9.78
Anxiety-Producing	121.10	11.41	109.10	7.62	115.10	9.52
Total	118.73	9.95	109.70	8.95	114.22	9.46
Control for Physiological Measures	115.70	7.54	113.10	11.12	114.40	9.33
Total	117.98	9.35	110.55	9.50	114.26	9.42
Control for Test Performance	115.80	10.56	110.20	9.40	113.00	9.98
Total	117.54	9.59	110.48	9.48	114.01	9.54

n = 20

TABLE 16

Means and Standard Deviations for Pulse Pressure

	Boys		Girls		Total	
Instruction Groups	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	50.30	8.56	41.30	4.81	45.8	6.68
Neutral	50.10	15.51	43.00	13.00	46.55	14.26
Anxiety-Producing	57.80	12.91	42.90	8.60	50.35	10.76
Total	52.73	12.33	42.40	8.80	47.57	10.57
Control for Physiological Measures	49.50	7.35	48.60	9.81	49.05	8.58
Total	51.92	11.08	43.95	9.05	47.94	10.07

n = 20

and Taylor (1961, p. 1025), point out that the rise in blood pressure is an adrenaline effect confined to the systolic phase.

The means in the present investigation are slightly lower than those presented by Best and Taylor (1961, p. 274). They consider the systolic blood pressure to be about 120 mm. for boys at about age 17 and about 4 or 5 mm. less for girls. The boys measure of 117.54 in the present study is only slightly more than 4 or 5 mm. greater than the girls' mean of 110.55. However, these scores would probably not be significantly different if they were independent of the normal sex difference. Since the pulse pressure is calculated to be the difference between the systolic and diastolic, a normal sex difference would also be true of pulse pressure. The means presented in Table 16 show the mean pulse pressure, which is the mean systolic minus the mean diastolic, for the instruction groups to be 52.73 mm. for the boys and 42.40 for the girls. With the control group included, the means were 51.92 and 43.95 for the boys and girls respectively. The figures in this investigation are slightly higher than the score of 40 presented by Best and Taylor (1961, p. 274) as being the pulse pressure for the average male adult.

The hypothesis that diastolic blood pressure would be higher for boys than for girls was rejected. There was no significant sex difference for diastolic blood pressure. The means are provided in Table 17. Brown and Van Gelder (1938) obtained an increase in diastolic blood pressure of 4.00 before an important examination and a -0.50 before a less important examination. Smith and Wenger (1965) obtained a mean of 80.09 before the examination and 76.14 for the comparative reading. These were significantly different at the .01 level. Best and Taylor (1961, p. 274) say the diastolic blood pressure of the male adult is about 80. These figures just presented are slightly higher than those obtained in the present study. According to Best and Taylor (1961, p. 1025) diastolic blood pressure is an adrenaline response which would result either in no change or a fall in pressure. Lacey and Lacey (1962, pp. 1257-1290, 1322-1326) found boys had inconsistently higher diastolic blood pressure than girls. The boys were consistently higher than the girls by 4 mm. Hg to 7 mm. Hg for the alerted level, significant at the .01 level of confidence. These findings, especially those of Best and Taylor and Lacey and Lacey, do not conclusively indicate higher diastolic blood pressure for the boys.

The girls' oral temperature was significantly

TABLE 17

Means and Standard Deviations for Mean Diastolic Blood Press.

	Boys		Girls		Total	
Instruction Groups	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	7.20	7.18	68.70	8.27	69.95	7.72
Neutral	65.90	8.54	68.90	4.58	67.44	6.56
Anxiety-Producing	65.10	5.32	66.90	6.26	66.00	5.79
Total	67.40	7.01	67.83	6.37	67.62	6.69
Control for Physiological Measures	66.60	5.85	64.90	5.17	65.75	5.51
Total	67.20	6.72	67.10	6.07	67.15	6.40
Control for Test Preformance	67.20	8.60	64.80	5.59	66.00	7.10
Total	67.20	7.10	66.64	5.97	67.03	6.54

n = 20

higher than that of the boys at less than the .01 level of confidence (Table 12 and Table 121 in Appendix B).

As shown in Table 18, the mean oral temperatures in degrees Fahrenheit were 99.81 and 100.11 for the boys girls, respectively, for the three instruction groups. With the control for oral temperatures averaged in, the means were 99.75 and 100.12 for the boys and girls, respectively. When the temperatures of the control subjects taken after the completion of the test were also averaged, the means for both sexes were 99.64 and 99.99 for the boys and girls, respectively.

The hypothesis that the girls' measures for respiration rate would be higher than those for the boys was confirmed. These differences were significant at less than the .01 level of confidence. (Table 12 and Table 112 in Appendix B). As presented in Table 19, the mean respiration rate for the three instruction groups was 17.73 respiratory cycles per minute for the boys and 19.74 for the girls. When the scores for the control groups were averaged in, the means were 17.55 for the boys and 19.05 for the girls. Brown and Van Gelder (1938) did not analyze the data by sex, but they found a rise in respiration rate of 3.06 before the most important examination and a -0.87 before the least important examination.

TABLE 18

Means and Standard Deviations for Oral Temperature

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	99.61	0.38	100.19	0.20	99.90	0.29
Neutral	99.94	0.37	100.27	0.51	100.10	0.44
Anxiety-Producing	99.87	0.34	99.89	0.23	99.88	0.28
Total	99.81	0.36	100.11	0.31	99.96	0.34
Control for Physiological Measures	99.58	0.33	100.15	0.49	99.86	0.41
Total	99.75	0.36	100.12	0.36	99.94	0.36
Control for Test Performance	99.19	0.70	99.45	0.38	99.32	0.54
Total	99.64	1.42	99.99	0.36	99.81	0.39

n = 20

TABLE 19

Means and Standard Deviations for Mean Respiration Rate

	Boys		Girls		Total	
Instruction Groups	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	18.58	2.99	21.31	3.18	19.94	3.08
Neutral	17.75	3.34	19.78	2.53	18.76	2.94
Anxiety-Producing	16.86	2.25	18.14	3.11	17.50	2.68
Total	17.73	2.86	19.74	2.94	18.73	2.90
Control for Physiological Measures	17.01	2.74	16.97	2.41	16.99	2.58
Total	17.55	2.83	19.05	2.81	18.30	2.82

n = 20

The hypothesis that the girls would have higher measures than the boys for respiration depth, heart beat rate, and GSR was rejected. There was no significant sex difference in the responses. (Tables 113-117, Appendix B). This was true for respiration depth and GSR for both the absolute scores and the change scores between the mean and the prereadings. The means are presented in Tables 20-24. Lacey and Lacey (1962, pp. 1257-1290; 1322-1326) obtained consistently higher heart beat rates for the girls than for the boys for each of the three levels; base, alert, and stress. The typical difference he found between the sexes was 10 beats per minute. Smith and Wenger (1965) were not concerned with a sex difference, but they did obtain a significant difference in means between the heart period just before a Ph.D. oral examination and the heart period for the comparative study. The heart period interpreted as heart beats per minute would be 85.7 before the Ph.D. examination and 68.5 for the comparative reading. These rates mentioned are higher than the ones of 71.72 and 83.74 for the boys and girls respectively, obtained in the present investigation. Perhaps the fact of the one test being a Ph.D. oral examination in contrast to the other, an experimental examination, accounted for part of the difference.

TABLE 20

Means and Standard Deviations for the Mean-The Prerespiration Depth

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	-2.22	6.68	0.49	8.06	-0.86	7.37
Neutral	1.72	4.83	-1.45	6.94	0.14	5.88
Anxiety-Producing	-1.13	9.68	-0.64	6.96	-0.88	8.32
Total	-0.54	7.06	0.53	7.32	-0.53	7.19
Control for Physiological Measures	1.00	6.40	-1.88	9.06	-0.44	7.73
Total	-0.16	6.90	-0.55	7.76	-0.51	7.32

n = 20

TABLE 21

Means and Standard Deviations for the Mean Respiration Depth

Instruction Groups	Boys Mean	 S.D.	Girls Mean	 S.D.	Total Mean	 S.D.
Anxiety-Reducing	28.68	10.45	21.37	10.24	25.02	10.34
Neutral	24.99	11.27	27.74	15.18	26.36	13.22
Anxiety-Producing	26.03	8.08	20.59	9.00	23.31	8.54
Total	26.57	9.93	23.23	11.47	24.90	10.70
Control for Physiological Measures	22.05	6.30	19.58	8.47	20.82	7.38
Total	25.44	9.02	22.32	10.72	23.88	9.87

n = 20

TABLE 22

Means and Standard Deviations for the Heart Beat Rate

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	73.90	9.13	84.80	11.68	79.35	10.40
Neutral	77.00	9.48	88.20	12.43	82.60	10.96
Anxiety-Producing	74.20	9.32	83.70	9.52	78.95	9.42
Total	74.03	9.31	85.57	11.21	80.30	10.26
Control for Physiological Measures	72.30	8.69	88.00	10.49	80.15	9.59
Total	74.35	9.16	86.18	11.03	80.26	10.09
Control for Test Performance	61.20	3.71	74.00	11.60	67.60	7.66
Total	71.72	8.07	83.74	11.14	77.73	9.61

n = 20

TABLE 23

Means and Standard Deviations for the Mean-Pre. GSR

	Boys		Girls		Total	
Instruction Groups	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	-7.8	14.34	-1.80	21.14	-4.8	17.74
Neutral	-6.0	10.94	-0.20	15.85	-3.1	13.40
Anxiety-Producing	-15.4	16.24	-4.30	9.76	-9.85	13.00
Total	-9.73	13.84	-2.10	15.58	-5.92	14.71
Control for Physiological Measures	2.40	16.67	0.00	25.69	1.2	21.18
Total	-6.70	14.55	-1.58	18.11	-4.14	16.33

n = 20

TABLE 24

Means and Standard Deviations for the GSR

Instruction Groups	Boys Mean	S.D.	Girls Mean	S.D.	Total Mean	S.D.
Anxiety-Reducing	74.50	22.65	69.70	33.02	72.10	27.84
Neutral	81.30	39.92	86.70	39.92	84.00	39.92
Anxiety-Producing	79.90	48.87	69.30	24.44	74.60	36.66
Total	78.57	37.15	75.23	32.46	76.90	34.81
Control for Physiological Measures	82.60	35.47	90.00	32.29	86.30	33.88
Total	79.58	36.73	78.92	32.42	79.25	34.58

n = 20

They did not obtain a significant difference between the examination reading and the comparative reading for palmer conductance (GSR) according to Stevens (1963, p. 474) the GSR is "one of the most popular measures of autonomic activity associated with affective and emotional states."

Table 12 provides a summary of the means for the physiological measures, along with the F's, p's and the sex with the highest score for the measures.

Although interpretations should be made with caution, the findings for this study indicate no significant differences between the sexes for respiration depth, heart beat rate, GSR, and diastolic blood pressure recorded during the test performance.

The equipment used for measuring the respiration gave a more valid measure of rate than of depth. In addition, respiration rate, respiration depth, and GSR are somewhat more vulnerable to inaccuracy than the other measures, due to slight movements unavoidably made by the subject during the time span of the examination. Very little change in response was expected for diastolic blood pressure.

An interesting observation is provided in Table 25, a summary of findings from Tables 13-24 and Tables 54-63 in Appendix B, which presents a comparison of the

TABLE 25

Comparison of Means for Initial Anxiety and Text Anxiety as Measured by Physiological Measures for the Three Instruction Groups and the Control

	Mean Pre-readings			Mean Test Readings		
	Boys	Girls	Higher	Boys	Girls	Higher
Resp. Rate	18.80	19.99	girls	17.55	19.05	girls
Resp. Depth	25.59	23.16	boys	25.44	22.32	boys
Heart Beat Rate	73.70	84.48	girls	71.72	83.74	girls
GSR	86.22	80.45	boys	79.58	78.92	boys
Syst. B.P.	120.75	115.22	boys	117.54	110.48	boys
Dias. B.P.	67.10	67.32	girls	67.20	66.85	boys
Pulse Pressure	54.40	47.82	boys	51.92	43.95	boys
Oral Temp.	99.04	99.42	girls	99.64	99.99	girls
Face Temp.	94.81	93.39	boys	95.98	95.15	boys
Finger Temp.	85.00	81.99	boys	87.42	83.86	boys

initial anxiety level and the mean test anxiety level. With every measure except that for pulse pressure, the sex group which scored higher in the first instance scored higher in the second instance.

Conclusion

The higher responses that girls usually make on paper-and-pencil tests of anxiety may not be entirely a reflection of a cultural difference in the admission of anxiety by the two sexes. An analysis of the patterning of autonomic variables, interpreted in view of the previous literature cited, may give evidence of a real difference in physiological sensitivity to test anxiety stimuli.

Hypothesis Six

There will be significant relationships within each treatment group among the following physiological measures of anxiety: respiration rate, respiration depth, heart beat rate, GSR, systolic blood pressure, diastolic blood pressure, pulse pressure, oral temperature, face temperature, and finger temperature.

Hypothesis six, that a significant relationship exists between the physiological measures of anxiety, was true for ten relationships, only one of which held up under all three degrees of anxiety elicited by the instructions. (See Tables 26-28). Systolic blood pressure related to pulse pressure positively and significantly at the .01 level of confidence for all three instruction groups. These correlations between the two measures were .64, .88, and .90 for the groups which received anxiety-reducing, neutral, and anxiety-producing instructions, respectively. In view of the fact that pulse pressure is computed to be the difference between the systolic and the diastolic blood pressure, the high relationship between the systolic blood pressure and pulse pressure is not surprising and in a sense may be spurious.

The second relationship found to be significantly correlated for the anxiety-reducing instructions was systolic blood pressure with diastolic blood pressure (.64, $p < .01$).

The five significant correlations for the neutral instruction group were: -.48 ($p < .05$) between respiration rate and pulse pressure, .88 ($p < .01$) between systolic blood pressure and pulse pressure, -.73 ($p < .01$) between diastolic blood pressure and pulse pressure, .53 ($p < .05$) between diastolic blood pressure and oral temperature, and -.54 ($p < .05$) between pulse pressure and oral temperature.

TABLE 26

Correlational Matrix of Physiological Measures of Anxiety for the Group with "Anxiety-Reducing Instruction"

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Resp. Rate-per min.	1.00	0.08	0.36	-0.07	-0.12	0.15	-0.35	0.10	0.24	-0.27
2. Resp. Depth[a] typ. cycle		1.00	-0.13	0.32	-0.07	0.18	-0.23	0.00	0.12	0.18
3. EKG - per min.			1.00	-0.09	-0.12	0.08	-0.21	0.26	-0.30	0.24
4. GSR[a]-micromhos				1.00	-0.31	-0.12	-0.29	0.31	0.30	0.25
5. Systolic B.P.-mm Hg					1.00	0.64**	0.64**	-0.27	0.12	-0.35
6. Diastolic B.P.-mm Hg						1.00	-0.16	-0.10	-0.13	0.01
7. Pulse Pressure - mm Hg							1.00	-0.27	0.06	-0.36
8. Oral Temp. degrees F.								1.00	-0.30	-0.08
9. Face Temp. degrees F.									1.00	0.14
10. Finger Temp. degrees F.										1.00

**Significant at .01 Level Two tailed test (n = 20) [a] mean minus the prereading

TABLE 27

Correlational Matrix of Physiological Measures of Anxiety for the Group with "Neutral Instruction"

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Resp. Rate-per min.	1.00	0.04	0.15	0.36	-0.40	0.42	-0.48*	0.41	0.02	0.13
2. Resp. Depth[a] typ. cycle		1.00	-0.36	-0.29	-0.24	-0.24	-0.03	0.04	0.08	-0.18
3. EKG - per min.			1.00	-0.25	0.14	0.40	-0.10	0.34	0.00	-0.05
4. GSR[a]-micromhos				1.00	-0.18	0.23	-0.25	0.28	0.15	0.32
5. Systolic B.P.-mm Hg					1.00	-0.36	0.88**	-0.36	-0.08	0.16
6. Diastolic B.P.-mm Hg						1.00	-0.73**	0.53*	0.34	0.16
7. Pulse Pressure-mm Hg							1.00	-0.54*	-0.23	0.02
8. Oral Temp. degrees F.								1.00	0.27	-0.00
9. Face Temp. degrees F.									1.00	0.36
10. Finger Temp. degrees F.										1.00

*Significant at .05 Level **Significant at .01 Level Two tailed test (n = 20)

[a] mean minus the prereading

TABLE 28

Correlational Matrix of the Physiological Measures of Anxiety for the Group with "Anxiety-Producing Instruction"

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Resp. Rate-per min.	1.00	0.19	-0.12	-0.00	0.11	-0.07	0.12	-0.03	-0.15	0.02
2. Resp. Depth[a] typ. cycle		1.00	0.04	-0.16	0.15	0.37	-0.07	-0.32	-0.08	0.18
3. EKG - per min.			1.00	-0.21	-0.40	-0.10	-0.32	0.13	-0.03	0.21
4. GSR[a]-micromhos				1.00	-0.15	0.41	-0.33	0.11	-0.10	-0.48*
5. Systolic B.P.-mm Hg					1.00	0.16	0.90**	0.16	-0.19	-0.25
6. Diastolic B.P.-mm Hg						1.00	-0.28	0.12	-0.22	-0.10
7. Pulse Pressure-mm Hg							1.00	0.15	-0.13	-0.24
8. Oral Temp. degrees F.								1.00	-0.18	0.08
9. Face Temp. degrees F.									1.00	0.56**
10. Finger Temp. degrees F.										1.00

*Significant at .05 Level **Significant at .01 Level Two tailed test (n = 20)

[a] mean minus the prereading

Three relationships which correlated significantly for the anxiety-producing instructions were: $-.48$ ($p < .05$) between GSR and finger temperature, $.90$ ($p < .01$) between systolic blood pressure and $.56$ ($p < .01$) between face temperature and finger temperature.

The other relationships, not mentioned were too low to attain the five per cent confidence level. By using the chi square significance test (Siegel, 1956, pp. 175-179), there was no significant difference among the three instruction groups for physiological measures. The chi square was 2.52 which was less than the five per cent level of significance.

The low correlations between physiological measures have been found by previous investigators. Ax (1953) and Lucio and Wenger (1961) obtained low correlations among physiological variables. After a study of the literature on physiological measures, Martin (1961) concluded that, "research thus far gives little ground for optimism that these variables will correlate very highly, if at all."

The low correlations in this investigation supported his general hypothesis, ". . . that there is marked uniqueness in physiological expression of emotion." I.G. Sarason (1960) also found evidence in the literature of marked individual differences among subjects in their physiological response patterns under stress conditions. Leminsohn's (1956) study involving finger tremors, heart rate, salivary output, and GSR, resulted in a general lack of intercorrelations among physiological measures. Jost (1953, pp. 3, 4) explained that some individuals are reactive in certain physiological areas and not in others.

Conclusion

Since the number of correlation coefficients attaining the .05 level of significance was not significantly greater than would be expected from chance alone (when spurious relationships are ignored), the overriding conclusion is that the physiological measures are essentially unrelated, and do not provide the basis for the identification of a preferred measure of anxiety. The uniqueness of the individual examinee's response pattern was expected, but not to the extent observed.

Hypothesis Seven

There will be a positive relationship between the following psychological measures of anxiety: S-R Inventory of Anxiousness (S-R I), Affect Adjective Check List (AACL), I. G. Sarason's Test Anxiety Scale (TAS), and Bendig's short form of Taylor's Manifest Anxiety Scale (MAS).

Results and Discussion

Table 29 provides the means, standard deviations, and Kuder-Richardson Formula 21 reliabilities for the Student Survey, composed of the four psychological tests given approximately two weeks before the major testing.

As can be observed, the reliabilities vary little from one group to another. The lowest correlation being .84 and the highest .88.

The means and standard deviations according to sex and treatment groups for the separate tests of which the Student Survey is composed are presented in Table 30.

Table 31 provides a summary of the results of the analysis of variance for the psychological test for instructions, proficiency levels, and sex. There were no significant differences in anxiety scores for instruction groups and proficiency levels. It should be remembered that the Student Survey, composed of the four psychological tests, was administered two weeks prior to, and independent of, the experimental environment. The students' instructions at that time were to score the scales according to their usual feelings. The AACL was administered again immediately following the anxiety

TABLE 29

Means, Standard Deviations, and Reliability Estimates of the Student Survey by Instruction Groups Administered Prior to the Major Testing

Instruction Groups	Mean	S.D.	Reliability K-R 21
1. Anxiety-Reducing	30.45	11.71	.88
2. Neutral	29.35	10.38	.85
3. Anxiety-Producing	28.00	11.07	.87
4. Control for Phys. Measure	31.00	10.03	.84
5. Control for Test Performance	28.62	10.84	.87

F value equals 0.61 for Instruction Groups

n = 20

TABLE 30

Means and Standard Deviations for the Psychological Test of Anxiety

Means and Standard Deviations for the Total Student Survey

Instruction Groups	Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	Total Mean	Total S.D.
Anxiety-Reducing	55.10	18.28	69.50	17.06	62.30	17.67
Neutral	46.40	16.40	67.70	13.78	57.05	15.09
Anxiety-Producing	50.80	13.80	67.70	15.35	59.25	14.58
Control for Physiological Measures	55.10	15.37	64.20	10.45	59.65	12.91
Control for Test Performance	58.80	17.55	65.70	20.23	62.25	18.89
Total	53.24	16.28	66.96	15.37	60.10	15.83

n = 20

TABLE 30--(Continued)

Means and Standard Deviations for S-R Inventory of Anxiousness

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	28.10	6.74	35.60	6.67	31.85	6.70
Neutral	27.90	5.84	32.30	5.72	30.10	5.78
Anxiety-Producing	27.10	4.63	32.80	7.07	29.95	5.85
Control for Physiological Measures	28.00	5.87	31.00	5.89	29.50	5.88
Control for Test Performance	31.00	7.15	34.30	10.08	32.65	8.62
Total	28.42	6.05	33.20	7.09	30.81	6.57

n = 20

TABLE 30--(Continued)

Means and Standard Deviations for the Affect Adjective Check List

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	11.10	5.66	13.60	5.89	12.35	5.78
Neutral	9.00	3.89	15.20	4.71	12.10	4.30
Anxiety-Producing	9.30	5.46	16.10	10.35	12.70	7.90
Control for Physiological Measures	12.70	5.40	12.00	4.76	12.35	5.08
Control for Test Performance	11.80	4.36	11.60	5.50	11.75	4.93
Total	10.80	4.95	13.70	6.24	12.25	5.60

n = 20

TABLE 30--(Continued)

Means and Standard Deviations for the Test Anxiety Scale

	Boys		Girls		Total	
Instruction Groups	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	6.90	4.09	10.10	3.60	8.50	3.84
Neutral	6.20	2.35	9.10	3.21	7.65	2.78
Anxiety-Producing	5.70	3.53	9.30	2.79	7.50	3.16
Control for Physiological Measures	6.60	3.75	9.80	2.35	8.20	3.05
Control for Test Performance	7.40	4.03	9.50	4.12	8.45	4.08
Total	6.56	3.55	9.56	3.21	8.06	3.38

n = 20

TABLE 30--(Continued)

Means and Standard Deviations for the Manifest Anxiety Scale

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	9.00	5.75	10.20	3.12	9.60	4.44
Neutral	8.10	2.56	11.10	4.28	9.60	3.42
Anxiety-Producing	8.70	4.50	9.50	3.63	9.10	4.06
Control for Physiological Measures	7.80	3.76	11.40	2.01	9.60	2.88
Control for Test Performance	8.50	5.30	10.30	4.57	9.40	4.94
Total	8.42	4.37	10.50	3.52	9.46	3.95

n = 20

TABLE 31

Summary of Analysis of Variance for the Psychological Test for Instruction, Proficiency and Sex

Test	F Instruction	F Proficiency	F Sex	Mean Highest
Total Student Survey	0.61	0.61	16.94	Girls**
S-R I	0.81	0.81	11.85	Girls**
AACL	0.13	0.65	9.30	Girls**
TAS	0.48	0.90	13.92	Girls**
MAS	0.05	0.51	3.74	Neither
AACL after Anxiety Instruction	0.66	0.02	0.52	Neither

**Significant at .01 Level

n = 20

instructions, with directions to score it according to their present feelings.

As can be observed from Table 31 and Tables 124-129 in Appendix B, there was a sex difference for the total score on the Student Survey, the S-R I, AACL, and the TAS, with the girls admitting more anxiety than the boys. The girls' MAS scores were just short of expressing significantly more anxiety than that of the boys. The responses on the scale just mentioned were concerned with the usual anxiety experienced. With the AACL administered just following the anxiety instructions,with the direction to score it according to the subjects' present feelings, there were no significant sex differences in the degree of anxiety experienced. Hypothesis Seven was confirmed. All the psychological measures of anxiety were positively related to each other, as can be observed in Table 32.

All the correlations were significant at the .01 level of confidence for the measures taken prior to the time of the major testing.

The correlations in the table ranged from .67 ($p < .01$) with the MAS to .82 ($p < .01$) with the TAS. Of the separate test that composed the Student Survey, there was a correlation of .65 ($p < .01$) between the TAS and the AACL, and .64 ($p < .01$) between the TAS

TABLE 32

Correlations among Psychological Measures for the Total Group

	1	2	3	4	5	6
1. Total Score Student Survey	1.00	0.78**	0.75**	0.82**	6.67**	0.25**
2. S-R I		1.00	0.40**	0.59**	0.41**	0.08
3. AACL			1.00	0.65**	0.36**	0.32**
4. TAS				1.00	0.64**	0.27**
5. MAS					1.00	0.21*
6. Affect Adjective Check List After Anxiety Instructions						1.00

*Significant at .05 Level **Significant at .01 Level

One tailed test (n = 100)

and the MAS.

I. G. Sarason (1961) reports correlations of .46 for men and .53 for women respectively between the TAS and MAS. The correlation between the AACL and the MAS was .36 ($p < .01$). These were the two scales that correlated .65 and .64 with the TAS, respectively.

Winter, et al. (1963) obtained a correlation of .44 ($p < .05$) between the AACL and the MAS.

In Zuckerman's (1960) study, the correlation was .28 between the AACL and the MAS.

Correlations between the S-R I (Endler, et al., 1962) and other measures were: .40 ($p < .01$) with the AACL, .59 ($p < .01$) with the TAS and .41 ($p < .01$) with the MAS. Endler et at. (1962) found a correlation of .46 ($p < .05$) between the S-R I and the MAS.

Conclusion:

The correlations in the present investigation compare favorably with those of other investigators; and considerable communality of measurement is reflected.

Hypothesis Eight

The Affect Adjective Check List, administered prior to the ability test, will have a positive relationship within each treatment group with the scores on the same measure obtained immediately following the instructions for the ability test.

Results and Discussion

Table 33 provides the means, standard deviations, and reliability estimates by treatment groups for the AACL administered after the instruction stimuli. The Kuder-Richardson Formula 20 varies from a low of .77 to a high of .88, whereas the Formula 21 varies from a low of .62 to a high of .80.

As can be observed from Table 34, hypothesis eight was confirmed. The AACL administered as a part of the Student Survey prior to the test, was positively related to the same measure given after the anxiety instructions.

The mean of the five correlations by conversion of the correlation to the corresponding Fisher's z, averaging and converting back to correlation was .40.

The correlations between the two testing occasions with the AACL were unexpectedly low. Those subjects who felt they did not usually experience a high degree of anxiety on an examination might have felt they were experiencing the greatest anxiety during the experimental test; and those who felt they usually experience a medium amount of anxiety might have felt that they were experiencing the smallest amount of anxiety during the experimental test situation.

TABLE 33

Means, Standard Deviations, and Reliability Estimates by Instruction Groups for the AACL Administered after the Instruction Stimuli

Instruction Groups	Mean	S.D.	Reliabilities K-R-20	K-R-21
1. Anxiety-Reducing	7.90	4.01	.77	.62
2. Neutral	8.20	4.48	.82	.69
3. Anxiety-Producing	7.68	5.36	.88	.80
4. Control for Phys. Measure	6.50	4.03	.82	.68
5. Control for Test Performance	9.90	4.49	.81	.65

F value equals .66 for Instruction Groups

n = 20

TABLE 34

Means and Correlations for the Affect Adjective Check List Administered Prior to the Major Testing and the Same Scale after the Anxiety Instructions

Instruction Groups	Correlations between 1st & 2nd Testing of AACL	Means of Usual Test Anxiety (1st Testing)		Means after Anxiety Instructions (2nd Testing)		Total Means Usual Test Anxiety (1st Testing)	Total Means after Anxiety Instructions (2nd Testing)
		Boys	Girls	Boys	Girls		
1. Anxiety-Reducing	.28	11.1	13.6	6.7	9.1	12.35	7.9
2. Neutral	.62**	9.0	15.2	6.9	11.1	12.10	9.0
3. Anxiety-Producing	.13	9.3	16.1	8.5	9.5	12.70	9.0
4. Control for Phys. Measures	.63**	12.7	12.0	7.8	11.4	12.35	9.6
5. Control for Test Performance	.27	11.9	11.6	10.3	9.5	11.75	9.9
Total Means[a]	.40*	10.9	13.7	8.0	10.1	12.25	9.08

*Significant at .05 Level **Significant at .01 Level n = 20 One Tailed Test

[a] Correlations converted to Fisher's z, averaged, and converted back to correlation

It is apparent from Table 34 that with every group the AACL indicated greater anxiety by the students during a regular examination than was experienced after the anxiety instructions in the experimental study. Since these results were unexpected, the investigator called many in the anxiety-producing group by phone and asked on which occasion they had experienced the most anxiety, i.e., during a regular important examination or during the experimental examination. Most of them replied that they did not know. Some added that they thought they experienced more during a regular classroom examination. Others said they experienced more anxiety when the physiological measures were being taken. It was interesting to observe the uniformity of their responses for the two testing situations, which provided a mean of 12.25 for the classroom examination, as compared with a mean of 9.08 after the instructions in the experimental setting. Higher scores indicate greater anxiety experienced. It was not known whether the difference in means was an actual difference in the anxiety experienced, or whether it was easier for the subjects to say they were usually more anxious in a testing situation than to say, "I am now afraid," and know that the investigators were standing near to receive their responses on the completed questionnaires.

In this connection there are also certain statistical limitations imposed on the interpretation of the differences obtained between the two testings. Windle (1954) found individuals to rate themselves on a personality test better the second time than on the first. In this study, since the higher scores represent greater anxiety, these students did, on the average, rate themselves better on the retest, thus providing lower scores on the second testing. By use of the t test this difference was significant at less than the .01 level. The test for homogenity of correlations (Edwards, 1950, pp. 83-84) indicated that the correlations were estimates of the same population, which gave rise to a common correlation of .41.

Conclusion

Hypothesis Eight was confirmed. A positive correlation was evidenced between the two testings with the AACL.

Hypothesis Nine

Within each treatment group there will be significant relationships among physiological and psychological measures of anxiety.

Results and Discussion

As presented in Tables 35-37, for the anxiety-reducing instruction group, four correlations were found to be significant. These correlations were systolic blood pressure with the total Student Survey ($-.54 p < .05$), and with the S-R I ($-.61 p < .01$), and pulse pressure with the total Student Survey ($-.48 p < .05$), and with the S-R I ($.49 p < .05$). All these significant relationships between the physiological and psychological measures were negative correlations. With the group performing under neutral instructions, two correlations between physiological and psychological measures were significant, namely: correlations between the AACL given after the anxiety instructions with respiration rate ($.51 p < .05$) and with oral temperature ($.48 p < .05$). As observed, both of these correlations were positive.

With the anxiety-producing instructions there were no correlations that reached the .05 level of significance.

Since only six of the 144 correlations were large enough to reject the null hypothesis, the information supplied by them must be considered essentially independent.

The low correlations between physiological and

TABLE 35

Correlations between Physiological and Psychological Measures of Anxiety for the Group with "Anxiety-Reducing" Instruction

		Total Student Survey	S-R I	AACL	TAS	MAS	AACL After Instruction
1.	Resp. Rate - per min.	0.07	0.14	0.15	0.08	-0.21	-0.11
2.	Resp. Depth[a]-typical resp. cycle	0.03	-0.04	0.08	0.25	-0.12	0.02
3.	EKG - per min.	0.24	0.16	0.20	0.16	0.31	0.31
4.	GSR[a]-micromhos	0.19	0.21	-0.04	0.24	0.27	0.15
5.	Systolic B. P. - mm HG	-0.54*	-0.61**	-0.39	-0.41	-0.34	-0.10
6.	Diastolic B. P. - mm Hg	-0.22	-0.34	-0.26	0.05	-0.05	-0.20
7.	Pulse Pressure - mm Hg	-0.48*	-0.49*	-0.23	-0.57	-0.34	0.03
8.	Oral Temp. degrees F.	0.22	0.37	-0.10	0.29	0.16	0.21
9.	Face Temp. degrees F.	-0.14	-0.18	-0.19	-0.05	0.00	-0.34
10.	Finger Temp. degrees F.	-0.25	0.11	0.14	0.28	0.43	0.19

*Significant at .05 Level

**Significant at .01 Level

Two tailed test (n = 20)

[a] mean minus the prereading

TABLE 36

Correlations between Physiological and Psychological Measures of Anxiety for the Group with "Neutral" Instructions

		Total Student Survey	S-R I	AACL	TAS	MAS	AACL After Instruction
1.	Resp. Rate - per min.	0.05	0.12	0.20	0.09	0.07	0.51*
2.	Resp. Depth[a]-typical resp. cycle	-0.35	-0.04	-0.22	-0.35	-0.29	-0.11
3.	EKG - per min.	0.29	-0.03	0.30	0.06	0.09	0.18
4.	GSR[a]-micromhos	0.18	0.03	0.13	0.14	0.34	0.20
5.	Systolic B. P. - mm Hg	-0.04	-0.06	-0.11	-0.25	0.01	-0.37
6.	Diastolic B. P. - mm Hg	0.17	0.01	0.07	-0.04	0.11	0.26
7.	Pulse Pressure - mm Hg	-0.12	-0.05	-0.10	-0.11	0.04	-0.37
8.	Oral Temp. degrees F.	0.32	0.15	0.25	0.09	0.16	0.48*
9.	Face Temp. degrees F.	-0.31	-0.28	-0.42	-0.30	-0.13	0.01
10.	Finger Temp. degrees F.	-0.19	-0.38	-0.26	-0.23	-0.03	0.10

*Significant at .05 Level   Two tailed test (n = 20)   [a] mean minus the prereading

TABLE 37

Correlations between Physiological and Psychological Measures of Anxiety for the Group with "Anxiety-Producing" Instruction

		Total Student Survey	S-R I	AACL	TAS	MAS	AACL After Instruction
1.	Resp. Rate - per min.	0.14	-0.24	0.28	0.29	0.09	0.31
2.	Resp. Depth[a]-typical resp. cycle	-0.05	0.20	0.01	-0.30	-0.27	-0.00
3.	EKG - per min.	0.27	0.30	0.26	0.15	-0.06	-0.34
4.	GSR[a]-micromhos	0.24	0.22	0.12	0.30	0.11	0.32
5.	Systolic B. P. - mm Hg	-0.25	-0.19	-0.18	-0.30	-0.05	0.26
6.	Diastolic B. P. - mm Hg	-0.08	0.12	-0.08	-0.26	-0.13	0.16
7.	Pulse Pressure - mm Hg	-0.20	-0.24	-0.13	-0.17	0.01	0.19
8.	Oral Temp. degrees F.	-0.10	-0.02	-0.03	-0.07	-0.26	0.02
9.	Face Temp. degrees F.	0.14	0.18	-0.02	0.13	0.24	-0.05
10.	Finger Temp. degrees F.	-0.16	-0.18	-0.05	-0.20	-0.07	-0.10

Two tailed test (n - 20)

[a] mean minus the prereading

psychological measures have been found by others. Endler et at. (1962) found negative and nonsignificant correlations between one physiological measure, the Palmar-Sweat Index, and Taylor's MAS, Mandler and Sarason's TAQ S-R I, and the MMPI K and L scales. Winter, et al. (1963) found no correlation between the Palmar-Sweat Index and the Taylor MAS.

Conclusion

This investigation suggests that the psychological responses and physiological responses are measurements of different factors.

Hypothesis Ten

Within each treatment group there will be significant relationships between psychological measures of anxiety and scores on the Academic Ability Test.

Results and Discussion (See Tables 38-41)

The test anxiety scale correlated negatively and significantly with the total and mathematical scores for the group performing under the influence of the anxiety-reducing and neutral instructions. The mathematical scores for the groups under anxiety-reducing and neutral instructions both showed a correlation of -.48 ($p < .05$). The TAS was also significantly correlated

TABLE 38

Correlations between Psychological Measures of Anxiety and Scores on the Academic Ability Test with Anxiety-Reducing Instructions

		Academic Ability Test		
		Total Score	Verbal Score	Math. Score
1.	Total Score Student Survey	-0.31	-0.14	-0.34
2.	S-R I	-0.26	-0.05	-0.40
3.	AACL	-0.06	0.02	-0.10
4.	TAS	-0.46*	-0.26	-0.48*
5.	MAS	-0.36	-0.31	-0.18
6.	AACL after Anxiety Instructions	0.23	0.20	0.12

*Significant at .05 Level

Two tailed test (n = 20)

TABLE 39

Correlations between Psychological Measures of Anxiety and Scores on the Academic Ability Test with Neutral Instructions

		Ability Test Score		
		Total Score	Verbal Score	Math. Score
1.	Total Score Student Survey	-0.23	-0.19	-0.23
2.	S-R I	0.24	0.35	0.09
3.	AACL	-0.32	-0.27	-0.32
4.	TAS	-0.48*	-0.41	-0.48*
5.	MAS	0.05	0.03	0.06
6.	AACL after the Test Instructions	-0.46*	-0.49*	-0.37

*Significant at .05 Level

Two tailed test (n = 20)

TABLE 40

Correlations between Psychological Measures of Anxiety and Scores on the Academic Ability Test with Anxiety-Producing Instructions

	Ability Test		
	Total Score	Verbal Score	Math. Score
1. Total Score Student Survey	0.48*	0.47*	0.35
2. S-R I	0.09	0.14	0.00
3. AACL	0.53*	0.58**	0.34
4. TAS	0.46*	0.41	0.36
5. MAS	0.27	0.08	0.38
6. AACL given just before the Test Instructions	0.12	0.03	0.14

*Significant at .05 Level

**Significant at .01 Level

Two tailed test (n = 20)

TABLE 41

Correlations between Psychological Measures of Anxiety and Scores on the Academic Ability Test with the Control for the Test Performance

	Academic Ability Test		
	Total Score	Verbal Score	Math. Score
1. Total Score Student Survey	0.06	-0.03	0.12
2. S-R I	-0.00	-0.06	0.04
3. AACL	0.24	0.06	0.32
4. TAS	-0.08	-0.12	-0.03
5. MAS	0.07	0.02	0.09
6. AACL given after Treatment Instructions	0.15	-0.00	0.22

*Significant at .05 Level

**Significant at .01 Level

Two tailed test (n = 20)

with the total scores for the anxiety-reducing and the anxiety-producing instruction groups. The correlations were -.46 for the anxiety-reducing instructions, and .46 for the anxiety-producing instructions, significant at the five per cent level of confidence.

The AACL, administered after the anxiety instructions, related negatively and significantly with the total score on the Academic Ability Test (-.46$p < .05$) and with the verbal scores (-.49$p < .05$) for the neutral instruction group.

For the anxiety-producing instruction group there were four significant correlations, besides the one for the TAS, with total scores on the Academic Ability Test. The total scores on the Student Survey correlated .48 ($p < .05$) and .47 ($p < .05$) with the total and verbal scores of the Academic Ability Test, respectively. The AACL correlated .53 ($p < .05$) and .58 ($p < .01$), with the total and verbal scores of the ability test, respectively.

None of the psychological measures of anxiety were significantly correlated with the total, verbal, or mathematical scores of the Academic Ability Test for the control for physiological measures.

In general, small to moderate negative relationships have been found between anxiety and scores on an ability test (Cowen, 1957; Sarason, I. G., 1963;

Sarason, S. B., 1960; Sarason, I. G., 1961).

Studies have shown the TAS to be more related to intellectual performance than is the MAS. (Sarason, I. G., Palola, 1960; Sarason, I. G., 1961; Walter, Denzler & Sarason, I. G., 1964). Farber and Spence (1955), over a period of years, were unable to find any relationship between the Taylor MAS and conventional measures of intellectual ability, such as entrance-examination scores and grade-point averages. Similar results were obtained in the present investigation.

Conclusion

The TAS was the most consistently related to test performance under varying anxiety stimuli. The MAS appeared to be unrelated to test performance.

Hypothesis Eleven

Within each treatment group there will be significant relationships between physiological measures of anxiety and performance on an ability test.

Results and Discussion

As presented in Tables 42-44, out of a possible 30 correlations for each instruction group, there were 8, 0, and 2 significant correlations for the anxiety-reducing, neutral, and anxiety-producing instruction

TABLE 42

Correlations between Physiological Measures of Anxiety and Scores on the Academic Ability Test with Anxiety-Reducing Instructions

	Academic Ability Test Total Score	Verbal Score	Math. Score
1. Respiration Rate - per min.	-0.33	-0.15	-0.50*
2. Resp. Depth^a - typical resp. cycle	-0.01	0.06	-0.11
3. EKG - per min.	-0.50*	-0.44*	-0.52*
4. GSR^a- micromhos	0.11	0.13	0.05
5. Systolic Bloos P. - mm Hg	-0.02	-0.29	0.31
6. Diastolic Blood P. - mm Hg	-0.55*	-0.61**	-0.30
7. Pulse Pressure - mm Hg	0.50*	0.22	0.71**
8. Oral Temperature degrees F.	-0.11	0.17	-0.33
9. Face Temperature degrees F.	0.01	-0.03	0.13
10. Finger Temperature degrees F.	-0.35	-0.30	-0.23

*Significant at .05 Level

**Significant at .01 Level

Two tailed test (n = 20)

^{a}mean minus the prereading

TABLE 43

Correlations between Psysiological Measures of Anxiety and Scores on the Academic Ability Test with Anxiety-Reducing Instructions

		Academic Ability Test		
		Total Score	Verbal Score	Math. Score
1.	Respiration Rate - per min.	-0.00	0.13	-0.13
2.	Resp. Depth[a] - typical resp. cycle	0.31	0.24	0.34
3.	EKG - per min.	-0.12	-0.06	-0.17
4.	GSR[a]- micromhos	-0.18	-0.09	-0.24
5.	Systolic Blood P. - mm Hg	0.13	0.14	0.11
6.	Diastolic Blood P. - mm Hg	0.01	-0.06	0.07
7.	Pulse Pressure - mm Hg	0.15	0.17	0.11
8.	Oral Temperature degrees F.	-0.23	-0.19	-0.24
9.	Face Temperature degrees F.	0.19	0.16	0.19
10.	Finger Temperature degrees F.	0.06	-0.02	0.13

Two tailed test (n = 20)

[a] mean minus the prereading

TABLE 44

Correlations between Physiological Measures of Anxiety and Scores on the Academic Ability Test with Anxiety "Producing Instructions"

		Total Score	Verbal Score	Math. Score
1.	Respiration Rate - per min.	0.38	0.42	0.23
2.	Resp. Depth[a] - typical resp. cycle	0.02	0.06	-0.08
3.	EKG - per min.	-0.23	-0.18	-0.28
4.	GSR[a] - micromhos	-0.06	0.20	-0.14
5.	Systolic Blood P. - mm Hg	-0.10	-0.09	-0.04
6.	Diastolic Blood P. - mm Hg	-0.14	-0.02	-0.31
7.	Pulse Pressure - mm Hg	-0.04	-0.08	0.09
8.	Oral Temperature degrees F.	-0.46*	-0.42	-0.48*
9.	Face Temperature degrees F.	-0.08	-0.18	0.03
10.	Finger Temperature degrees F.	-0.28	-0.38	-0.18

*Significant at .05 Level

Two tailed test (n = 20)

[a] mean minus the prereading

groups, respectively.

Of the eight significant correlations between physiological measures and test performance, respiration rate, heart beat rate, diastolic blood pressure, and pulse pressure were related to test performance. Heart beat rate related to test performance with significant negative correlations of -.50 ($p < .05$), -.44 ($p < .05$), and -.52 ($p < .05$) for the total, verbal, and mathematical scores, respectively. Pulse pressure correlated at .50 ($p < .05$) and .71 ($p < .01$) with the total and mathematical scores respectively. The correlations between diastolic blood pressure and the total and verbal scores were -.55 ($p < .05$) and -.61 ($p < .01$) respectively. One other significant correlation was that of -.50 ($p < .05$) between respiration rate and mathematical scores.

There were no significant correlations between physiological responses and test performance with neutral instructions. The highest correlation was that of .34 between respiration depth and the mathematical scores.

Only one significant correlation resulted between physiological responses and the Academic Ability Test under the influence of the anxiety-producing instructions. This significant correlation was -.46 ($p < .05$) between oral temperature and the total score on the

Academic Ability Test. These relationships appear to be greater than those found in many studies using paper-and-pencil scales. Ruebush (1963, p. 497), as a result of a study of the literature, found anxiety as measured by a questionnaire, to have a moderate negative relationship with aptitude scores. I. G. Sarason (1960) reported that the majority of the studies have yielded nonsignificant correlations between the MAS and intelligence, whereas test anxiety yields negative correlations. Dana (1957) found a nonsignificant correlation between the MAS and the Wechsler-Bellevue, Form I intelligence test. S. B. Sarason (1960, pp. 125-135) reports correlations of -.25, -.23, -.24, and -.28 for grades three, four, five, and six between the Test Anxiety Scale for Children and IQ scores. He also reports correlations of -.12, -.19, -.16, and -.06 between the General Anxiety Scale for Children and IQ scores for grades three, four, five, and six, respectively. The correlations in this study compare favorably with the paper-and-pencil test as indices of anxiety.

Conclusion

With the anxiety-reducing instructions eight correlations out of a possible thirty were significant.

Only two other correlations were significant and those were with anxiety-producing instructions.

The implications found in this study support the fact that further research is needed, using physiological measures, test performance and manipulated anxiety. Measures of special interest may be heart beat rate and blood pressures.

According to this investigation, under anxiety reducing instructions, better performance is suggested by a slower heart beat rate, lower diastolic blood pressure, and greater pulse pressure. This relationship between diastolic blood pressure and pulse pressure is to be expected since pulse pressure is the difference between the diastolic and systolic blood pressures. The lower the diastolic and the higher the systolic blood pressures, the greater is the pulse pressure. Further research is needed with use of these measures.

Summary

The findings in the present investigation suggest the following statements of observation.

1. According to the present investigation there was no significant difference in performance under various types of instruction stimuli.

2. There was no significant difference in

performance under the various types of instruction stimuli with the initial level of anxiety held constant; but there were significant instructions by sex interactions when the initial level of anxiety was held constant, with the girl's performance being superior to that of the boys with anxiety-producing instructions.

3. The treatment groups did not differ in physiological responses during the examination with one exception, respiration rate, which did not follow the predicted pattern. The physiological measures were essentially independent within each treatment group, a finding that confirms the complexity of the construct.

4. The boys' measures for systolic blood pressure, pulse pressure, face temperature, and finger temperature were significantly higher than those for the girls. Respiration rate and oral temperature were significantly higher for the girls than for the boys. There was no sex difference in responses for changes in respiration depth, heart beat rate, GSR, and diastolic blood pressure. Higher scores do not necessarily indicate a greater degree of anxiety experienced. There was no clear indication of greater anxiety, as revealed by physiological responses, for either sex. Even though there were significant differences for many of the physiological measures.

5. Unlike the physiological measures, all four of the psychological measures of anxiety were positively and moderately interrelated and significant at the .01 level of confidence.

6. The AACL administered prior to the major testing as part of the Student Survey did not correlate well with the AACL given after the anxiety stimulus. There was a significant reduction in experienced anxiety for each group but the difference did not vary significantly between groups. The t test revealed a significant difference between the two testings at less than the .01 level of significance.

7. The physiological and psychological measures of anxiety were not generally correlated to a significant degree.

8. Correlations between the psychological measures of anxiety and the Academic Ability Test performance were largely influenced by the rationale inherent in their construction. The TAS and the AACL were moderately related with performance on the ability test. The MAS, designed to measure general anxiety, and the S-R I, largely concerned with situational anxiety, were essentially unrelated to ability test performance.

9. The significant correlations between

physiological measures of anxiety and performance on the Academic Ability Test were largely concerned with oral temperature, heart beat rate, pulse pressure, diastolic blood pressure, and respiration rate. The number of significant correlations is not greatly in excess of that which would be dictated by chance.

10. All but one of the six significant correlations between the physiological measures and scores on the Academic Ability Test involved the group who received the anxiety-reducing instructions. Significant correlations were obtained between scores on the Academic Ability Test and the following measures: oral temperature, heart beat rate, pulse pressure, diastolic blood pressure, and respiration rate. All these correlations were negative except pulse pressure. Considering the chance factors, the number of significant correlations yielded is unimpressive.

11. Since no significant differences were obtained between treatment groups for performance on the ability test, all groups were combined in order that a multiple correlation could be computed. This was done in an attempt to predict ability test scores from a combination of physiological measures. Both absolute and change readings were used. The multiple correlation, after correction for shrinkage, failed to

reach the 5 per cent significance level. The results of this investigation should be interpreted with due caution.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this chapter was to summarize the investigation and the results of the study and to present recommendations that have developed.

Problem

The principal problems of the study concerned the following issues: (a) the extent to which experimentally induced anxiety influences ability test performance; and (b) the extent to which the various physiological and psychological measures of anxiety are related.

Procedure

All high school seniors enrolled in any of the nine sections of the United States Government classes at West High School in the Torrance Unified School District were administered the following four self-report anxiety measures: (a) Endler, Hunt, and Rosenstein's S-R Inventory of anxiousness,

(b) Zuckerman's Affect Adjective Check List; (c) I.G. Sarason's Test Anxiety Scale, and (d) Bendig's Short Form of Taylor's Manifest Anxiety Scale.

Request for parental permission to involve the students in the study was sought until an excess of 100 subjects were available. The students were then assigned at random to one of five treatment groups, stratified by sex and proficiency level (by ITED scores). Thus there were five subjects in each of the twenty cells of the 5 x 2 x 2 (treatments by proficiency levels by sex) design. In three of the five groups, each subject received one of the following types of anxiety stimuli: (a) anxiety-reducing instructions, (b) neutral instructions, and (c) anxiety-producing instructions. Two separate control groups were required: one which took the same tests but without concomitant physiological instrumentation, and another which had the instrumentation but engaged in non-test behavior (reading).

The three treatment groups were administered the Academic Ability Test concurrent with the recording of the following physiological measures: respiration rate, respiration depth, heart beat rate, galvanic skin response, systolic blood pressure, diastolic blood pressure, pulse pressure, oral temperature, face temperature, and finger temperature. The other two groups were controls. The control for test performance, took the ability test without the physiological measures being recorded at the time of testing. These, however, had pulse rate, oral temperature, systolic blood pressure, and diastolic blood pressure recorded at the completion of the test. All groups took the AACL (part II of the Student Survey) after the anxiety stimulus (instructions) with directions to score it according to their present feelings.

Analysis of the Data

The basic statistical model for the analysis of the data was a three-way analysis of variance (treatments-by-proficiency levels-by-sex).

The dependent variables included verbal, mathematical, and total ability test scores, in addition to the several physiological and psychological measures. Analysis of covariance with the same factorial design was computed with the ability test scores using the initial level of anxiety (prereadings) held constant. Correlational analyses were also performed on all anxiety measures.

Findings

An analysis of the data provides the following summary statements.

1. There was no significant difference among treatment groups with respect to performance on the verbal, mathematical, or total ability test scores, with or without the initial anxiety level held constant.

    a. There was a significant interaction between sex and the anxiety stimuli (instructions) for the total and mathematical scores on the ability test when the initial level of anxiety was held constant. Performance of the girls under anxiety-producing instructions surpassed that of the boys under the same instructions.

2. Among the physiological measures, respiration rate alone was significantly different among the treatment groups. This fact suggests the strong possibility that in actuality the instructions, although phrased as strongly as ethically possible, did not manipulate differential anxiety in the examinees.

3. There were no significant differences between the proficiency levels for the physiological responses.

4. The physiological measures of face temperature, finger temperature, systolic blood pressure, and pulse pressure were significantly higher for the boys than for the girls. Respiration rate and oral temperature were significantly higher for the girls than for the boys. (Higher measures do not necessarily indicate greater anxiety.) There were no significant differences between the responses of the boys and those of the girls for: diastolic blood pressure, GSR, respiration depth, and heart beat rate.

5. Systolic blood pressure consistently showed a significant positive relationship to pulse pressure under all three anxiety stimuli (instructions). The neutral instruction group yielded more significant correlations than the other two treatment groups. However, when chi square, as described in Siegel (1956, pp. 174-179), was computed for significant differences in number of significant correlations between the treatment groups, no significant difference among groups emerged.

Pulse pressure was significantly related to:

a. systolic blood pressure,
b. diastolic blood pressure,
c. respiration rate, and
d. oral temperature.

Other significant correlations were: respiration depth with heart beat rate, and systolic blood pressure; diastolic blood pressure with oral temperature; and face temperature with finger temperature. The important generalization evolving from the interrelationship is that they were essentially independent, i.e., they were not generally correlated either in absolute magnitude or in change.

6. All psychological measures of anxiety were positively and moderately related to each other (median r = .50). Correlations among the four psychological measures ranged from .36 between the AACL and the MAS to .65 between the TAS and the AACL.

7. The AACL administered prior to the major testing as part of the Student Survey was only moderately (median r = .28) related to the AACL administered just following the anxiety stimulus. There was no significant relationship between the two testings with the AACL for the anxiety-producing instruction group. There were significant correlations between the two testings for the neutral instruction group and the control for physiological measures. These correlations were .62 and .63 for neutral and control, respectively. However, the test of homogeneity of correlations (Edwards, 1950, pp. 83, 84)

revealed no significant difference. They were all estimates of the same population giving rise to a correlation of .41 as an estimate of the common population.

8. The physiological and psychological measures were essentially uncorrelated.

9. The TAS and the AACL were significantly related to test performance.

10. All but one of the six significant correlations between the physiological measures and scores on the Academic Ability Test were with the groups who received the anxiety-reducing instructions. Significant correlations were obtained between scores on the Academic Ability Test and the following measures: oral temperature, heart beat rate, pulse pressure, diastolic blood pressure, and respiration rate. All these correlations were negative except pulse pressure. Considering the chance factor, the number of significant correlations is not impressive.

11. Since differences between treatment groups on the ability tests were not significant, all groups were pooled to determine a multiple correlation, predicting Academic Ability Test scores from the optimal combination of physiological measures, using both absolute and change readings. The multiple R, after

being corrected for shrinkage, failed to prove significant. This finding suggests that either;

a. anxiety is not a hindrance in test performance within the limits generated in this study, or

b. test anxiety is not measured by these physiological responses. These findings are independent of the question as to whether anxiety was experimentally manipulated or not.

Recommendations

1. In subsequent anxiety studies it is recommended that investigators take into account the extreme complexity and multidimensional nature of the construct, anxiety. Several measures which have been used singly as indicators of anxiety were unrelated to other measures used for the same purpose.

2. Investigators should be careful to emphasize the type of anxiety measured by self-report paper-and-pencil instruments. The type of anxiety measured by anxiety scales is not the type of anxiety exhibited through the physiological changes that are often used to describe anxiety.

3. The study should be repeated in a more

natural setting in order to determine whether, in this situation, instruction stimuli are significant in generating anxiety. In the present study the examinees were not differentially affected by instruction in either test performance or physiological responses.

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APPENDICES

APPENDIX A

LETTER FOR APPROVAL TO THE PARENTS
COOPERATIVE ACADEMIC ABILITY TEST
THE STUDENT SURVEY PARTS I, II, III, IV

TORRANCE UNIFIED SCHOOL DISTRICT

West High School
20401 Victor
Torrance, California

November 12, 1964

Dear Parents:

West High School is participating in a research program which is sponsored by the University of Southern California; Loma Linda University and the Department of Health, Education, and Welfare. The purpose of the study is to assist in the development of more valid, reliable achievement and intelligence tests by determining the possible effect of certain factors on test scores.

While the student is taking an educational test, certain physiological measures, temperature, pulse rate, blood pressure, perspiration, and respiration will be recorded to determine whether they are related to success on the test. The entire amount of student time involved will be one class period.

Your student has been chosen by random sampling to participate in the project. If you approve of his/her participation please indicate by placing your signature below.

Sincerely,

Kenneth D Hopkins
Dr. Kenneth D. Hopkins

Alma C. Chambers

Alma C. Chambers

____
Parent Signature

Approved:

Robert R Ford
Dr. Robert Ford

COOPERATIVE ACADEMIC ABILITY TEST

Due to the limited time available for performance on the test the middle question of each three was eliminated. This procedure reduced the length of the test by one third. The remaining questions were placed in order at random by use of a random table of numbers (Kendall & Smith, 1938). This arrangement provided opportunity for individuals unable to complete the test in the time provided to attempt a proportion of the more difficult questions usually placed at the end of a test.

The following list provides the numbers of the questions and the arrangement used for the verbal section and the same for the mathematical section.

Questions

43
49
36
7
31
9
25
28
13
1
6
10
37
24
27
45
33
22
42
30
4
21
12
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39
40
15
3
48
46

INSTRUCTIONS FOR THE STUDENT SURVEY

We are interested in knowing how students feel while taking an important examination. The best way we know of to find this out is to ask you how you feel on such an occasion. This is a general survey and not especially related to how you feel toward any course in particular.

Although we are not especially interested in the response of each person individually, we still would like your true attitude. One of the main reasons for conducting this survey is the fact that very little is known about people's feelings toward the taking of various kinds of tests. We assume that people differ in the degree to which they are affected by the fact that they are going to take a test, or by the fact that they have taken a test. What we are particularly interested in here is how people differ in their opinions and reactions to the various kinds of testing situations. The value of this survey will depend in a large part on how frank you are in stating your opinions, feelings, and attitudes. Read each statement carefully and make your immediate response. Do not ponder over these statements. Your response to this survey will be held strictly confidential. Great care will be taken in the use of the information received. Your response will not in any way affect your grade in this course or any other course.

STUDENT SURVEY

Please do _not_ write or mark on this booklet in any way. Your answers to the statements in this inventory are to be recorded only on the separate ANSWER SHEET.

Remember to give YOUR OWN opinions. _Please do not leave any question unanswered_. Make your marks heavy and black. Erase completely any answer you wish to change. Please notice the choices on the ANSWER SHEET read from left to right.

This inventory represents a means of studying people's reactions during an important examination. Certain common types of personal reactions and feelings to examinations are listed. Indicate choices on the ANSWER SHEET, which represent the degree to which you would show certain reactions and feelings during an important examination. Here is an example:

You are taking an important examination.

	---	---	---	---	---
Heart beats faster	1---	2---	3---	4---	5---
	not at all				much faster

If your heart beats much faster in this situation, you would darken alternative 5 on the **ANSWER SHEET**; if your heart beats somewhat faster, you would darken either alternative 2, 3, or 4, depending on how much faster; if in this situation your heart does not beat faster at all, you would darken alternative 1 on the **ANSWER SHEET**.

If you have no questions, you may begin.

PART I

"You are Taking an Important Examination"

PLEASE DO NOT MARK THIS BOOKLET

Mark on the ANSWER SHEET one of the five alternative degrees of reactions or attitude for each of the following 14 items.

1.	Heart beats faster	1	2	3	4	5
		Not at all				Much faster
2.	Get an "uneasy feeling"	1	2	3	4	5
		None				Very strongly
3.	Emotions disturb action	1	2	3	4	5
		Not at all				Very disturbed
4.	Feel excited and thrilled	1	2	3	4	5
		Very much				Not at all
5.	Want to avoid situation	1	2	3	4	5
		Not at all				Very much
6.	Perspire	1	2	3	4	5
		Not at all				Perspire much
7.	Need to urinate frequently	1	2	3	4	5
		Not at all				Very frequently

8. Enjoy the challenge 1 2 3 4 5

Enjoy much — Not at all

9. Mouth gets dry 1 2 3 4 5

Not at all — Very dry

10. Become unable to move 1 2 3 4 5

Not at all — Completely

11. Get full feeling in stomach 1 2 3 4 5

None — Very full

12. Seek experiences like this 1 2 3 4 5

Very much — Not at all

13. Have loose bowels 1 2 3 4 5

None — Very much

14. Experience nausea 1 2 3 4 5

Not at all — Much nausea

PART II

For Parts II, III, and IV, there are only two choices, true or false, to each question.

Below you will find words which describe different kinds of feelings. Please mark "true" by darkening alternative "1" on the ANSWER SHEET for the words that describe how you feel while taking an important examination. Mark "false" by darkening alternative "2" on the ANSWER SHEET for the words that do not describe your feelings while taking an important examination. Some of the words sound alike but we want your response to all the words indicating whether they do or do not describe your feeling while taking an important examination by darkening either alternative 1 or 2 on the ANSWER SHEET. Remember: True = 1, False = 2.

Afraid

If this word is true or usually true, as applied to you, darken the first alternative.

(True) (False)

1______ 2.______ 3______ 4______ 5______

If the word is false or not usually true, as applied to you, darken the second alternative.

15. afraid
16. agitated
17. angry
18. bitter
19. calm
20. charming
21. cheerful
22. complaining
23. contented
24. contrary
25. cool
26. cross
27. desperate
28. easy-going
29. fearful
30. fearless
31. fretful
32. friendly
33. frightened
34. furious
35. gay
36. gloomy
37. grim
38. happy
39. helpless
40. hopeless
41. insecure
42. jealous
43. joyful
44. kindly
45. light-hearted
46. lonely
47. loving
48. mad
49. mean
50. merry
51. miserable
52. nervous
53. overconcerned
54. overwhelmed
55. panicky
56. peaceful
57. pleasant
58. rattled
59. sad
60. secure
61. sentimental
62. serious
63. shaky
64. solemn
65. steady
66. tender
67. tense
68. terrified
69. threatened
70. thoughtful
71. unconcerned
72. uneasy
73. upset
74. warm
75. worrying

PART III

Continue to answer the statements in Part III by giving your first reaction. Mark "1" for true and "2" for "false" as you did in Part II.

76. While taking an important examination, I perspire a great deal.

77. I get to feel very panicky when I have to take a surprise exam.

78. During tests, I find myself thinking of the consequences of failing.

79. After important tests, I am frequently so tense that my stomach gets upset.

80. While taking an important exam, I find myself thinking of how much brighter the other students are than I am.

81. I freeze up on things like intelligence tests and final exams.

82. If I were to take an intelligence test, I would worry a great deal before taking it.

83. During course examinations, I find myself thinking of things unrelated to the actual course material.

84. During a course examination, I frequently get so nervous, that I forget facts I really know.

85. If I knew I was going to take an intelligence test, I would feel confident and relaxed before hand.

86. I usually get depressed after taking a test.

87. I have an uneasy, upset feeling before taking a final examination.

88. When taking a test, my emotional feelings do not interfere with my performance.

89. Getting a good grade on one test doesn't seem to increase my confidence on the second.

90. After taking a test, I always feel I could have done better than I actually did.

91. I sometimes feel my heart beating very fast during important tests.

PART IV

The following questions are concerned with your feelings toward general experiences in life, not just on examinations. Mark "1" for "true" and "2" for "false" as before.

92. I believe I am no more nervous than most others.
93. I work under a great deal of tension.
94. I cannot keep my mind on one thing.
95. I am more sensitive than most other people.
96. I frequently find myself worrying about something.
97. I am usually calm and not easily upset.
98. I feel anxiety about something or someone almost all the time.
99. I am happy most of the time.
100. I have periods of such great restlessness that I cannot sit long in a chair.
101. I have sometimes felt that difficulties were piling up so high that I could not overcome them.
102. I certainly feel useless at times.
103. I find it hard to keep my mind on a task or job.
104. I am not unusually self-conscious.
105. I am inclined to take things hard.
106. I am a high-strung person.
107. Life is a strain for me much of the time.

108. At times I think I am no good at all.

109. I am certainly lacking in self-confidence.

110. I sometimes feel that I am about to go to pieces.

111. I shrink from facing a crisis or difficulty.

APPENDIX B

TABLES OF THE ANALYSIS OF THE DATA

TABLE 45

Results of the Analysis of Variance for the Date the Letter of Approval was Received

Source of Variation	df	Mean Square	F
A-Instruction	3	306.53	0.69
B-Proficiency	1	0.62	0.00
C-Sex	1	900.59	2.04
A X B	3	314.66	0.71
A X C	3	677.34	1.53
B X C	1	26.22	0.06
A X B X C	3	633.66	1.43
Within	63	442.21	--
Total	78		

TABLE 46

Results of the Analysis of Variance for the Period of the Day for Testing the Students

Source of Variation	df	Mean Square	F
A-Instruction	3	6.09	1.25
B-Proficiency	1	0.15	0.03
C-Sex	1	0.25	0.05
A X B	3	0.78	0.16
A X C	3	3.94	0.81
B X C	1	0.25	0.05
A X B X C	3	1.28	0.26
Within	64	4.87	--
Total	79		

TABLE 47

Results of the Analysis of Variance for the Day of Testing for Each Student

Source of Variation	df	Mean Square	F
A-Instruction	3	10.82	1.96
B-Proficiency	1	0.74	0.14
C-Sex	1	10.96	1.98
A X B	3	1.66	0.30
A X C	3	7.37	1.33
B X C	1	0.00	0.00
A X B X C	3	15.10	2.73
Within	64	5.52	--
Total	79		

TABLE 48

Results of the Analysis of Variance for the Prediastolic Blood Pressure for the Three Instruction Groups and the Control for Physiological Measures

Source of Variation	df	Mean Square	F
A-Instruction	3	84.97	1.78
B-Proficiency	1	181.75	3.80
C-Sex	1	2.00	0.04
A X B	3	25.90	0.54
A X C	3	20.87	0.44
B X C	1	3.10	0.06
A X B X C	3	25.52	0.53
Within	62	47.80	
Total	77		

TABLE 49

Results of the Analysis of Variance for Preoral Temperature for the Three Instruction Groups and the Control Groups for Physiological Measures

Source of variation	df	Mean square	F
A-Instruction	3	0.56	1.64
B-Proficiency	1	0.88	2.57
C-Sex	1	2.95	8.59**[a]
A X B	3	0.03	0.08
A X C	3	1.14	3.31*
B X C	1	0.03	0.09
A X B X C	3	0.43	1.26
Within	64	0.34	--
Total	79		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 50

Results of the Analysis of Variance for the Presystolic Blood Pressure for the Three Instruction Groups and the Control Group for Physiological Measures

Source of variation	df	Mean square	F
A-Instruction	3	5.15	0.04
B-Proficiency	1	41.64	0.36
C-Sex	1	559.28	4.81*[a]
A X B	3	209.64	1.80
A X C	3	253.76	2.18
B X C	1	112.89	0.97
A X B X C	3	84.64	0.73
Within	62	116.28	--
Total	77		

*Significant at .05 Level

[a] Boys > Girls

TABLE 51

Results of the Analysis of Variance for the Initial Pulse Pressure for the Three Instruction Groups and the Control Group for Physiological Measures

Source of variation	df	Mean Square	F
A-Instruction	3	125.69	0.91
B-Proficiency	1	30.35	0.22
C-Sex	1	686.30	4.99**[a]
A X B	3	212.27	1.54
A X C	3	244.01	1.77
B X C	1	112.90	0.82
A X B X C	3	72.91	0.09
Within	64	137.63	--
Total	79		

**Significant at .01 Level

[a] Boys > Girls

TABLE 52

Results of the Analysis of Variance for the Prefinger Temperature for the Three Instruction Groups and the Control Group for Physiological Measures

Source of variation	df	Mean Square	F
A-Instruction	3	18.84	0.56
B-Proficiency	1	3.52	0.10
C-Sex	1	173.60	5.13*a
A X B	3	49.32	1.46
A X C	3	27.63	0.82
B X C	1	49.01	1.45
A X B X C	3	11.41	0.34
Within	64	33.85	--
Total	79		

*Significant at .05 Level

[a]Boys > Girls

TABLE 53

Results of the Analysis of Variance for the Initial Face Temperature for the Three Instruction Groups and the Control Group for Physiological Measures

Source of variation	df	Mean Square	F
A-Instruction	3	3.16	0.86
B-Proficiency	1	0.54	0.15
C-Sex	1	40.66	11.10**[a]
A X B	3	3.42	0.17
A X C	3	0.07	0.93
B X C	1	0.20	0.06
A X B X C	3	2.33	0.64
Within	64	3.66	--
Total	79		

**Significant at .01 Level

[a] Boys > Girls

TABLE 54

Means and Standard Deviations for Prereading Respiration Rate

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	17.89	3.53	22.60	3.40	20.24	3.46
Neutral	17.50	2.79	20.55	3.73	19.03	3.26
Anxiety-Producing	17.46	2.88	19.21	2.88	18.34	2.88
Total	17.62	3.07	20.79	3.34	19.20	3.20
Control for Physiological Measures	18.36	3.57	17.59	3.94	17.98	3.76
Total	18.80	3.19	19.99	3.49	18.90	3.34

TABLE 55

Means and Standard Deviations for Prereading Respiration Depth

	Boys		Girls		Total	
Instruction Groups	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	30.90	11.40	20.85	9.16	25.88	10.28
Neutral	23.25	9.11	29.15	13.79	26.20	11.45
Anxiety-Producing	27.15	11.26	21.20	9.28	24.18	10.27
Total	27.10	10.59	23.73	10.74	25.42	10.67
Control for Physiological Measures	21.05	4.55	21.45	10.54	21.25	7.54
Total	25.59	9.08	23.16	10.69	24.38	9.88

TABLE 56

Means and Standard Deviations for Prereading Heart Beat Rate

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	72.80	10.13	84.80	16.60	78.80	13.36
Neutral	74.70	12.07	85.00	11.12	79.85	11.60
Anxiety-Producing	74.60	11.55	80.30	12.88	77.45	12.22
Total	74.03	11.25	83.37	13.53	78.70	12.39
Control for Physiological Measures	72.70	11.52	87.80	12.87	80.25	12.20
Total	73.70	11.32	84.48	13.37	79.09	12.34

TABLE 57

Means and Standard Deviations for Prereading GSR

Instruction Groups	Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	Total Mean	Total S.D.
Anxiety-Reducing	82.20	21.14	71.50	15.28	76.85	18.21
Neutral	87.20	38.85	86.80	28.13	87.00	33.49
Anxiety-Producing	95.30	62.86	73.50	16.64	84.40	39.75
Total	88.23	40.95	77.27	20.02	82.75	30.48
Control for Physiological Measures	80.20	28.54	90.00	43.92	85.10	36.23
Total	86.22	37.85	80.45	25.99	83.34	31.92

TABLE 58

Means and Standard Deviations for Prereading Systolic Blood Pressure

Instruction Groups	Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	Total Mean	Total S.D.
Anxiety-Reducing	121.80	10.34	115.40	10.67	118.60	10.50
Neutral	116.20	10.48	118.22	11.89	117.21	11.18
Anxiety-Producing	126.00	12.30	110.67	7.07	118.34	9.68
Total	121.33	11.04	114.76	9.88	118.05	10.45
Control for Physiological Measures	119.00	11.60	116.60	11.43	117.80	11.52
Total	120.75	11.18	115.22	10.26	117.99	10.72

TABLE 59

Means and Standard Deviations for Prereading Diastolic Blood Pressure

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	69.40	7.18	68.80	8.23	69.10	7.70
Neutral	67.40	9.04	70.00	5.92	68.70	7.48
Anxiety-Producing	64.00	4.90	64.89	6.79	64.44	5.84
Total	66.93	7.04	67.90	6.98	67.41	7.01
Control for Physiological Measures	67.60	5.48	65.60	6.38	66.60	5.93
Total	67.10	6.65	67.32	6.83	67.21	6.74

TABLE 60

Means and Standard Deviations for Prereading Pulse Pressures

Instruction Groups	Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	Total Mean	Total S.D.
Anxiety-Reducing	52.40	12.72	46.60	9.29	49.50	11.00
Neutral	48.80	14.91	47.50	13.74	48.15	14.32
Anxiety-Producing	62.00	12.80	46.20	6.49	54.10	9.64
Total	54.40	13.48	46.77	9.84	50.58	11.65
Control for Physiological Measures	51.40	10.96	51.00	9.10	51.20	10.03
Total	54.40	22.86	47.82	9.66	50.74	11.25

TABLE 61

Means and Standard Deviations for Prereading Oral Temperature

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	99.18	0.52	99.52	0.38	99.35	0.45
Neutral	98.93	0.58	99.70	0.68	99.32	0.63
Anxiety-Producing	99.11	0.65	98.84	0.59	98.98	0.62
Total	99.07	0.58	99.35	0.55	99.22	0.57
Control for Physiological Measures	98.94	0.62	99.60	0.56	99.27	0.59
Total	99.04	0.59	99.42	0.55	99.23	0.57

TABLE 62

Means and Standard Deviations for Face Temperature

Instruction Groups	Boys		Girls		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Anxiety-Reducing	95.29	1.79	92.77	1.40	94.03	1.60
Neutral	94.86	1.65	94.26	1.50	94.56	1.58
Anxiety-Producing	94.65	1.32	93.72	1.96	94.18	1.64
Total	94.93	1.59	93.58	1.62	94.26	1.60
Control for Physiological Measures	94.43	1.59	92.80	2.96	93.62	2.28
Total	94.81	1.59	93.39	1.96	94.10	1.78

TABLE 63

Means and Standard Deviations for Finger Temperature

Instruction Groups	Boys Mean	Boys S.D.	Girls Mean	Girls S.D.	Total Mean	Total S.D.
Anxiety-Reducing	84.06	7.02	83.75	5.23	83.90	6.12
Neutral	85.17	5.83	83.36	4.48	84.26	5.16
Anxiety-Producing	84.46	7.33	79.61	2.57	82.04	4.95
Total	84.56	6.73	82.24	4.09	83.40	5.41
Control for Physiological Measures	86.29	6.62	81.25	5.69	83.77	6.61
Total	85.00	6.70	81.99	4.49	83.49	5.60

TABLE 64

Results of the Analysis of Covariance for the Total Test Score with the Initial Respiration Rate Held Constant

Source of variation	df	Mean Square	F
A-Instruction	2	50.15	1.21
B-Proficiency	1	3047.72	73.34**
C-Sex	1	2.15	0.05
A X B	2	15.55	0.37
A X C	2	172.20	4.14*
B X C	1	77.24	1.86
A X B X C	2	46.54	1.12
Within	47	41.55	
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 65

Results of the Analysis of Covariance for the Verbal Score With the Initial Respiration Rate Held Constant

Source of variation	df	Mean Square	F
A-Instruction	2	12.40	1.00
B-Proficiency	1	877.20	70.5**
C-Sex	1	63.86	5.14*[a]
A X B	2	5.52	0.44
A X C	2	28.72	2.31
B X C	1	17.78	1.43
A X B X C	2	10.11	0.81
Within	47	12.43	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 66

Results of the Analysis of Covariance for the Mathematical Score with the Initial Respiration Rate Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	21.00	1.29
B-Proficiency	1	615.91	37.97**
C-Sex	1	56.29	3.47
A X B	2	8.44	0.52
A X C	2	57.63	3.55*
B X C	1	15.98	0.98
A X B X C	2	8.18	0.50
Within	47	16.22	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 67

Results of Analysis of Covariance for the Total Test Scores with Differences Between Prereading and Test Reading Respiration Depth Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	48.38	1.16
B-Proficiency	1	3015.40	72.59**
C-Sex	1	8.32	.20
A X B	2	16.61	0.40
A X C	2	165.82	3.99*
B X C	1	68.42	1.65
A X B X C	2	43.19	1.04
Within	47	41.54	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 68

Results of Analysis of Covariance for the Verbal Scores With Differences Between the Prereading and Test Reading Respiration Depth Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	13.76	1.11
B-Proficiency	1	862.01	69.77**
C-Sex	1	69.91	5.66*[a]
A X B	2	5.77	.47
A X C	2	28.87	2.34
B X C	1	16.75	1.36
A X B X C	2	10.24	.83
Within	47	12.35	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 69

Results of Analysis of Covariance for the Mathematical Scores with Differences Between Prereading and Test Reading Respiration Depth Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	21.57	1.33
B-Proficiency	1	613.22	37.75**
C-Sex	1	60.29	3.71
A X B	2	8.82	.54
A X C	2	58.12	3.58*
B X C	1	15.09	.93
A X B X C	2	8.06	.05
Within	47	16.24	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 70

Results of the Analysis of Covariance for the Total Test Score with the Initial Respiration Depth Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	40.72	1.00
B-Proficiency	1	3110.10	76.49**
C-Sex	1	2.50	0.06
A X B	2	19.41	0.48
A X C	2	162.78	4.00*
B X C	1	44.93	1.10
A X B X C	2	51.78	1.27
Within	47	40.66	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 71

Results of the Analysis of Covariance for the Verbal Score With the Initial Respiration Depth Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	10.20	0.88
B-Proficiency	1	907.25	78.29**
C-Sex	1	50.17	4.33*a
A X B	2	8.38	0.72
A X C	2	23.92	2.06
B X C	1	7.36	0.64
A X B X C	2	14.67	1.26
Within	47	11.59	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a]Girls > Boys

TABLE 72

Results of the Analysis of Covariance for the Mathematical Score with the Initial Respiration Depth Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	20.96	1.29
B-Proficiency	1	619.45	38.26**
C-Sex	1	62.80	3.88
A X B	2	8.67	.54
A X C	2	59.10	3.65*
B X C	1	11.88	0.73
A X B X C	2	9.20	0.57
Within	47	16.19	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 73

Results of the Analysis of Covariance for the Total Test Score with the Initial Heart Beat Rate Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	47.75	1.16
B-Proficiency	1	3080.94	74.59**
C-Sex	1	12.23	0.30
A X B	2	20.26	0.49
A X C	2	171.12	4.14*
B X C	1	73.12	1.77
A X B X C	2	35.68	0.86
Within	47	41.30	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 74

Results of the Analysis of Covariance for the Verbal Score with the Initial Heart Beat Rate Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	14.20	1.14
B-Proficiency	1	863.73	69.61**
C-Sex	1	67.57	5.44*[a]
A X B	2	4.78	0.38
A X C	2	29.96	2.41
B X C	1	18.48	1.49
A X B X C	2	11.32	0.91
Within	47	12.41	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 75

Results of the Analysis of Covariance for the Mathematical Score with the Initial Heart Beat Rate Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	25.58	1.66
B-Proficiency	1	640.45	41.56**
C-Sex	1	48.52	3.15
A X B	2	13.31	0.86
A X C	2	58.67	3.81*
B X C	1	15.09	0.98
A X B X C	2	3.67	0.24
Within	47	15.41	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 76

Results of Analysis of Covariance for the Total Test Scores with Differences Between Prereading and Test Reading GSR Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	38.16	.92
B-Proficiency	1	3066.90	73.96**
C-Sex	1	13.52	.32
A X B	2	14.22	.34
A X C	2	169.34	4.08*
B X C	1	69.84	1.68
A X B X C	2	42.49	1.02
Within	47	41.47	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 77

Results of Analysis of Covariance for the Verbal Scores with Differences Between Prereading and Test Reading GSR Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	12.63	1.02
B-Proficiency	1	876.59	70.46**
C-Sex	1	68.88	5.54*[a]
A X B	2	5.45	.44
A X C	2	30.68	2.47
B X C	1	18.21	1.46
A X B X C	2	10.47	0.84
Within	47	12.44	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 78

Results of the Analysis of Covariance for the Mathematical Scores with Differences Between Prereading and Test Reading GSR Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	18.35	1.16
B-Proficiency	1	621.81	39.16**
C-Sex	1	45.05	2.84
A X B	2	6.63	.42
A X C	2	58.72	3.70*
B X C	1	13.53	.85
A X B X C	2	10.47	.62
Within	47	15.88	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 79

Results of the Analysis of Covariance for the Total Test Score with the Initial GSR Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	46.96	1.17
B-Proficiency	1	2940.11	73.12**
C-Sex	1	7.69	0.19
A X B	2	15.69	0.39
A X C	2	161.43	4.01*
B X C	1	103.50	2.57
A X B X C	2	26.37	0.66
Within	47	40.21	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 80

Results of the Analysis of Covariance for the Verbal Score with the Initial GSR Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	12.59	1.02
B-Proficiency	1	857.68	69.33**
C-Sex	1	70.25	5.68*a
A X B	2	4.26	0.34
A X C	2	30.76	2.49
B X C	1	20.97	1.69
A X B X C	2	8.37	0.68
Within	47	12.37	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 81

Results of the Analysis of Covariance for the Mathematical Score with the Initial GSR Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	24.99	1.60
B-Proficiency	1	586.88	37.48**
C-Sex	1	62.19	3.97
A X B	2	12.48	0.80
A X C	2	52.36	3.34*
B X C	1	24.44	1.56
A X B X C	2	2.59	0.16
Within	47	15.66	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 82

Results of the Analysis of Covariance for the Total Test Score with the Initial Systolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	41.28	0.97
B-Proficiency	1	2856.37	67.20**
C-Sex	1	26.54	0.62
A X B	2	14.41	0.34
A X C	2	183.08	4.31*
B X C	1	74.77	1.76
A X B X C	2	41.31	0.97
Within	45	42.50	--
Total	56		

*Significant at .05 Level

**Significant at .01 Level

TABLE 83

Results of the Analysis of Covariance for the Verbal Score with Initial Systolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	12.62	1.00
B-Proficiency	1	819.90	64.84**
C-Sex	1	85.43	6.76*[a]
A X B	2	4.55	0.36
A X C	2	33.44	2.64
B X C	1	18.98	1.50
A X B X C	2	9.38	0.74
Within	45	12.64	--
Total	56		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 84

Results of the Analysis of Covariance for the Mathematical Score with the Initial Systolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	19.08	1.15
B-Proficiency	1	572.99	34.52**
C-Sex	1	35.66	2.15
A X B	2	8.36	0.50
A X C	2	64.23	3.87*
B X C	1	16.00	0.96
A X B X C	2	9.09	0.55
Within	45	16.60	--
Total	56		

*Significant at .05 Level

**Significant at .01 Level

TABLE 85

Results of the Analysis of Covariance for the Total Test Score with the Initial Diastolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	20.82	0.53
B-Proficiency	1	2406.16	61.38**
C-Sex	1	18.32	0.47
A X B	2	17.11	0.44
A X C	2	166.62	4.25*
B X C	1	74.45	1.90
A X B X C	2	31.47	0.80
Within	45	39.20	--
Total	56		

*Significant at .05 Level

**Significant at .01 Level

TABLE 86

Results of the Analysis of Covariance for the Verbal Score with the Initial Diastolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	2.70	0.24
B-Proficiency	1	672.02	60.32**
C-Sex	1	85.27	7.65**[a]
A X B	2	4.00	0.36
A X C	2	26.82	2.41
B X C	1	19.31	1.73
A X B X C	2	7.24	0.65
Within	45	11.14	--
Total	56		

**Significant at .01 Level

[a] Girls > Boys

TABLE 87

Results of the Analysis of Covariance for the Mathematical Score with the Initial Diastolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	18.81	1.16
B-Proficiency	1	488.39	30.15**
C-Sex	1	51.50	3.18
A X B	2	11.25	0.69
A X C	2	60.98	3.76*
B X C	1	15.25	0.94
A X B X C	2	5.09	0.31
Within	45	16.20	--
Total	56		

*Significant at .05 Level

**Significant at .01 Level

TABLE 88

Results of the Analysis of Covariance for the Total Score with the Initial Pulse Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	26.80	0.71
B-Proficiency	1	2743.48	72.61**
C-Sex	1	52.50	1.38
A X B	2	25.04	0.66
A X C	2	221.89	5.87**
B X C	1	97.14	2.57
A X B X C	2	51.59	1.36
Within	47	37.78	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 89

Results of the Analysis of Covariance for the Verbal Score with the Initial Pulse Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	6.76	0.61
B-Proficiency	1	777.96	70.60**
C-Sex	1	112.69	10.22**[a]
A X B	2	8.30	0.75
A X C	2	46.78	4.24*
B X C	1	25.59	2.32
A X B X C	2	12.80	1.16
Within	47	11.02	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 90

Results of the Analysis of Covariance for the Mathematical Score with the Initial Pulse Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	17.38	1.14
B-Proficiency	1	549.66	35.98**
C-Sex	1	26.40	1.73
A X B	2	11.86	0.78
A X C	2	70.40	4.62*
B X C	1	20.35	1.38
A X B X C	2	9.73	0.64
Within	47	15.0	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 91

Results of the Analysis of Covariance for the Total Test Score with the Initial Oral Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	40.69	0.98
B-Proficiency	1	2925.44	70.83**
C-Sex	1	17.88	0.43
A X B	2	17.83	0.43
A X C	2	144.15	3.49*
B X C	1	74.51	1.80
A X B X C	2	50.13	1.21
Within	45	41.30	--
Total	56		

*Significant at .05 Level

**Significant at .01 Level

TABLE 92

Results of the Analysis of Covariance for the Verbal Score with the Initial Oral Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	9.11	0.76
B-Proficiency	1	819.61	68.41**
C-Sex	1	89.22	7.45**[a]
A X B	2	6.41	0.54
A X C	2	20.10	1.68
B X C	1	18.86	1.57
A X B X C	2	14.33	1.20
Within	47	11.98	--
Total	58		

**Significant at .01 Level

[a] Girls > Boys

TABLE 93

Results of the Analysis of Covariance for the Mathematical Test Score with the Initial Oral Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	21.24	1.31
B-Proficiency	1	598.15	36.86**
C-Sex	1	50.24	3.10
A X B	2	9.08	0.56
A X C	2	55.84	3.44*
B X C	1	15.50	0.96
A X B X C	2	8.28	0.51
Within	47	16.22	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 94

Results of the Analysis of Covariance for the Total Test Score with the Initial Face Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	48.63	1.17
B-Proficiency	1	3061.52	73.43**
C-Sex	1	11.24	0.27
A X B	2	15.49	0.37
A X C	2	162.51	3.90*
B X C	1	75.72	1.82
A X B X C	2	43.25	1.04
Within	47	41.69	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 95

Results of the Analysis of Covariance for the Verbal Score with the Initial Face Temperature held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	13.63	1.10
B-Proficiency	1	876.33	70.45**
C-Sex	1	58.10	4.67*[a]
A X B	2	5.56	0.45
A X C	2	30.73	2.47
B X C	1	17.78	1.43
A X B X C	2	10.68	0.86
Within	47	12.44	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 96

Results of the Analysis of Covariance for the Mathematical Score with the Initial Face Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	22.14	1.36
B-Proficiency	1	618.47	38.13**
C-Sex	1	45.36	2.80
A X B	2	8.44	0.52
A X C	2	53.44	3.29*
B X C	1	16.21	1.00
A X B X C	2	7.52	0.46
Within	47	16.22	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 97

Results of the Analysis of Covariance for the Total Test Score with the Initial Finger Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	31.51	0.84
B-Proficiency	1	3026.66	80.40**
C-Sex	1	0.10	0.00
A X B	2	23.24	0.62
A X C	2	134.19	3.56*
B X C	1	107.89	2.86
A X B X C	2	49.61	1.32
Within	47	37.65	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

TABLE 98

Results of the Analysis of Covariance for the Verbal Test Score with the Initial Finger Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	8.45	0.76
B-Proficiency	1	866.59	77.58**
C-Sex	1	46.56	4.17*[a]
A X B	2	5.64	0.50
A X C	2	24.37	2.18
B X C	1	28.10	2.52
A X B X C	2	12.49	1.12
Within	47	11.17	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 99

Results of the Analysis of Covariance for the Mathematical Test Score with the Initial Finger Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	2	18.94	1.22
B-Proficiency	1	611.62	39.43**
C-Sex	1	76.17	4.91*a
A X B	2	13.22	0.85
A X C	2	48.66	3.14
B X C	1	21.98	1.42
A X B X C	2	7.33	0.47
Within	47	15.51	--
Total	58		

*Significant at .05 Level

**Significant at .01 Level

[a] Boys > Girls

TABLE 100

Results of the Analysis of Covariance for the Total Test Score for the Three Instruction Group and the Control Group with the Mean EKG Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	28.72	0.68
B-Proficiency	1	2868.47	68.20**
C-Sex	1	1.11	0.03
A X B	3	27.53	0.65
A X C	3	86.00	2.04
B X C	1	0.58	0.01
A X B X C	3	88.83	2.11
Within	62	42.06	--
Total	77		

**Significant at .01 Level

TABLE 101

Results of the Analysis of Covariance for the Verbal Score for the Three Instruction Groups and the Control Group with the Mean EKG Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	16.30	1.25
B-Proficiency	1	692.23	53.06**
C-Sex	1	87.85	6.73*[a]
A X B	3	23.42	1.79
A X C	3	11.18	0.86
B X C	1	4.73	0.36
A X B X C	3	11.36	0.87
Within	62	13.04	--
Total	77		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 102

Results of the Analysis of Covariance for the Mathematical Score for the Three Instruction Groups and the Control Group with the Mean EKG Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	15.58	0.98
B-Proficiency	1	730.07	45.79**
C-Sex	1	86.26	5.41*[a]
A X B	3	3.77	0.24
A X C	3	41.62	2.61
B X C	1	1.53	0.10
A X B X C	3	36.66	2.30
Within	62	15.94	--
Total	77		

*Significant at .05 Level

**Significant at .01 Level

[a] Boys > Girls

TABLE 103

Results of the Analysis of Covariance for the Total Test Score for the Three Instruction Groups and the Control Group with the Mean Systolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	24.00	0.57
B-Proficiency	1	3169.82	75.29**
C-Sex	1	3.76	0.09
A X B	3	36.04	0.86
A X C	3	87.74	2.08
B X C	1	4.10	0.10
A X B X C	3	82.67	1.96
Within	63	42.10	--
Total	78		

**Significant at .01 Level

TABLE 104

Results of the Analysis of Covariance for the Verbal Score for the Three Instruction Groups and the Control Group with the Mean Systolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	7.73	0.57
B-Proficiency	1	800.84	59.22**
C-Sex	1	103.17	7.63**a
A X B	3	29.28	2.16
A X C	3	13.47	1.00
B X C	1	9.17	0.68
A X B X C	3	10.28	0.76
Within	63	13.52	
Total	78		

**Significant at .01 Level

[a]Girls > Boys

TABLE 105

Results of the Analysis of Covariance for the Mathematical Score for the Three Instruction Groups and the Control Group with the Mean Systolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	17.34	1.11
B-Proficiency	1	777.60	49.76**
C-Sex	1	89.38	5.72*[a]
A X B	3	3.51	0.22
A X C	3	42.16	2.70
B X C	1	0.67	0.04
A X B X C	3	38.04	2.43
Within	63	15.63	
Total	78		

*Significant at .05 Level

**Significant at .01 Level

[a] Boys > Girls

TABLE 106

Results of the Analysis of Covariance for the Total Test Score for the Three Instruction Groups and the Control with the Mean Diastolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	30.90	0.75
B-Proficiency	1	3230.47	78.17**
C-Sex	1	0.44	0.01
A X B	3	17.70	0.43
A X C	3	94.94	2.30
B X C	1	0.28	0.01
A X B X C	3	93.48	2.26
Within	63	41.32	
Total	78		

**Significant at .01 Level

TABLE 107

Results of the Analysis of Covariance for the Verbal Score for the Three Instruction Groups and the Control Group with the Mean Diastolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	8.76	0.64
B-Proficiency	1	822.11	60.54**
C-Sex	1	89.68	6.60*a
A X B	3	19.32	1.42
A X C	3	11.97	0.88
B X C	1	4.94	0.36
A X B X C	3	10.84	0.80
Within	63	13.58	
Total	78		

*Significant at .05 Level

**Significant at .01 Level

aGirls > Boys

TABLE 108

Results of the Analysis of Covariance for the Mathematical Score for the Three Instruction Groups and the Control Group with the Mean Diastolic Blood Pressure Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	21.57	1.42
B-Proficiency	1	790.26	52.00**
C-Sex	1	140.76	9.26**a
A X B	3	6.90	0.45
A X C	3	48.39	3.18*
B X C	1	2.70	0.18
A X B X C	3	43.08	2.83
Within	63	15.20	
Total	78		

*Significant at .05 Level

**Significant at .01 Level

[a] Boys > Girls

TABLE 109

Results of the Analysis of Covariance for the Three Instruction Groups and the Control Group with the Mean Oral Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	36.64	0.85
B-Proficiency	1	3251.83	77.22**
C-Sex	1	5.09	0.12
A X B	3	29.28	0.70
A X C	3	92.36	2.19
B X C	1	0.89	0.02
A X B X C	3	87.68	2.08
Within	63	42.11	
Total	78		

**Significant at .01 Level

TABLE 110

Results of the Analysis of Covariance for the Verbal Score for the Three Instruction Groups and the Control Group with the Mean Oral Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	8.42	0.61
B-Proficiency	1	803.55	58.54**
C-Sex	1	77.49	5.64*[a]
A X B	3	25.44	1.85
A X C	3	11.85	0.86
B X C	1	5.74	0.42
A X B X C	3	9.52	0.69
Within	63	13.73	
Total	78		

*Significant at .05 Level

**Significant at .01 Level

[a] Girls > Boys

TABLE 111

Results of the Analysis of Covariance for the Mathematical Score for the Three Instruction Groups and the Control Group with the Mean Oral Temperature Held Constant

Source of Variation	df	Mean Square	F
A-Instruction	3	26.14	1.70
B-Proficiency	1	521.59	53.57**
C-Sex	1	162.64	10.61**[a]
A X B	3	4.35	0.28
A X C	3	48.10	3.14*
B X C	1	1.98	0.13
A X B X C	3	42.98	2.80
Within	63	15.34	
Total			

*Significant at .05 Level

**Significant at .01 Level

[a] Boys > Girls

TABLE 112

Results of the Analysis of Variance for the Mean Respiration Rate for the Three Instruction Groups and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	36.19	4.35**a
B-Proficiency	1	.20	.02
C-Sex	1	40.01	4.81*b
A X B	3	7.49	.90
A X C	3	6.59	.79
B X C	1	7.90	.95
A X B X C	3	6.37	.76
Within	64	8.32	--
Total	79		

*Significant at .05 Level

**Significant at .01 Level

[a] Anxiety-reducing instruction group neutral > Anxiety-producing control for physiological measures.

[b] Girls > Boys

TABLE 113

Results of the Analysis of Variance for the Mean Minus the Initial Respiration Depth for the Three Instruction Groups and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	1.92	0.03
B-Proficiency	1	2.85	0.05
C-Sex	1	5.26	0.09
A X B	3	17.22	0.30
A X C	3	33.92	0.59
B X C	1	5.78	0.10
A X B X C	3	85.03	1.48
Within	64	57.56	
Total	79		

TABLE 114

Results of the Analysis of Variance for the Mean Respiration Depth for the Three Instruction Groups and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	112.35	1.08
B-Proficiency	1	95.09	0.92
C-Sex	1	191.06	1.84
A X B	3	47.39	0.46
A X C	3	94.87	0.91
B X C	1	191.67	1.85
A X B X C	3	130.20	1.25
Within	64	103.75	--
Total	79		

TABLE 115

Results of the Analysis of Variance for the Mean Heart Beat Rate for the Three Instruction Groups and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	4736.45	1.07
B-Proficiency	1	1598.11	0.36
C-Sex	1	98.90	0.02
A X B	3	4275.53	0.97
A X C	3	3984.14	0.90
B X C	1	3312.04	0.75
A X B X C	3	2781.91	0.63
Within	64	4419.11	
Total	79		

TABLE 116

Results of the Analysis of Variance for the Mean Minus the Prereading GSR for the Three Instruction Groups and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	431.94	1.41
B-Proficiency	1	41.28	0.13
C-Sex	1	438.36	1.43
A X B	3	48.76	0.16
A X C	3	155.63	0.51
B X C	1	20.03	0.06
A X B X C	3	343.34	1.12
Within	64	306.54	
Total	79		

TABLE 117

Results of the Analysis of Variance for the Mean GSR for the Three Instruction Groups and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	944.41	0.76
B-Proficiency	1	552.93	0.44
C-Sex	1	5.23	0.00
A X B	3	1626.52	1.30
A X C	3	371.20	0.30
B X C	1	98.89	0.08
A X B X C	3	1805.93	1.45
Within	64	1246.41	--
Total	79		

TABLE 118

Results of the Analysis of Variance for the Mean Systolic Blood Pressure for the Three Instruction Groups and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	24.47	0.27
B-Proficiency	1	145.56	1.63
C-Sex	1	1109.97	12.43**a
A X B	3	133.12	1.49
A X C	3	119.25	1.34
B X C	1	201.22	2.25
A X B X C	3	40.04	0.45
Within	64	89.32	--
Total	79		

**Significant at .01 Level

[a] Boys < Girls

TABLE 119

Results of the Analysis of Variance for the Mean Diastolic Blood Pressure for the Three Instruction Groups and The Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	74.04	1.68
B-Proficiency	1	49.20	1.12
C-Sex	1	1.51	0.03
A X B	3	56.27	1.28
A X C	3	39.91	0.91
B X C	1	0.99	0.02
A X B X C	3	16.41	0.37
Within	64	43.99	--
Total	79		

TABLE 120

Results of the Analysis of Variance for the Mean Pulse Pressure for the Three Instructions and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	84.14	0.77
B-Proficiency	1	1.78	0.02
C-Sex	1	1314.80	12.10**a
A X B	3	256.31	2.36
A X C	3	164.94	1.52
B X C	1	215.56	1.98
A X B X C	3	63.14	0.58
Within	64	108.68	
Total	79		

**Significant at .01 Level

[a] Boys < Girls

TABLE 121

Results of the Analysis of Variance for the Mean Oral Temperature for the Three Instruction Groups and the Control

Source of Variation	df	Mean Square	F
A-Instruction	3	0.26	1.77
B-Proficiency	1	0.23	1.53
C-Sex	1	2.70	18.22**a
A X B	3	0.07	0.46
A X C	3	0.35	2.34
B X C	1	0.08	0.58
A X B X C	3	0.02	0.10
Within	64	0.15	--
Total	79		

**Significant at .01 Level

[a] Girls < Boys

TABLE 122

Results of the Analysis of Variance for the Mean Face Temperature for the Three Instruction Groups and the Control

Source of Variation	df	Mean Square	F
A-Instruction	3	4.32	1.97
B-Proficiency	1	0.09	0.04
C-Sex	1	13.41	6.12*[a]
A X B	3	0.05	0.02
A X C	3	0.47	0.22
B X C	1	0.02	0.01
A X B X C	3	0.08	0.04
Within	64	2.19	
Total	79		

*Significant at .05 Level

[a] Boys < Girls

TABLE 123

Results of the Analysis of Variance for the Mean Finger Temperature for the Three Instruction Groups and the Control Group

Source of Variation	df	Mean Square	F
A-Instruction	3	40.94	0.82
B-Proficiency	1	5.64	0.11
C-Sex	1	246.41	4.96*[a]
A X B	3	45.93	0.92
A X C	3	53.71	1.08
B X C	1	5.62	0.11
A X B X C	3	14.08	0.28
Within	64	49.66	
Total	79		

*Significant at .05 Level

[a] Boys $<$ Girls

TABLE 124

Results of the Analysis of Variance for the Affect Adjective Check List Administered After the Instruction Stimuli

Source of Variation	df	Mean Square	F
A-Instruction	3	16.27	0.66
B-Proficiency	1	0.45	0.02
C-Sex	1	12.67	0.52
A X B	3	12.37	0.50
A X C	3	15.88	0.64
B X C	1	0.20	0.01
A X B X C	3	5.21	0.21
Within	64	24.59	
Total	79		

TABLE 125

Results of Analysis of Variance for the Total Student Survey

Source of Variation	df	Mean Square	F
A-Instruction	3	166.31	0.61
B-Proficiency	1	167.82	0.61
C-Sex	1	4640.82	16.94**[a]
A X B	3	141.85	0.52
A X C	3	219.22	0.80
B X C	1	105.78	0.39
A X B X C	3	648.74	2.38
Within	64	274.02	
Total	79		

**Significant at .01 Level

[a] Girls < Boys

TABLE 126

Results of Analysis of Variance for the S-R Inventory of Anxiousness

Source of Variation	df	Mean Square	F
A-Instruction	3	38.58	0.81
B-Proficiency	1	38.80	0.81
C-Sex	1	566.57	11.85**[a]
A X B	3	8.49	0.18
A X C	3	15.24	0.32
B X C	1	16.03	0.34
A X B X C	3	93.38	1.93
Within	64	47.81	
Total	79		

**Significant at .01 Level

[a] Girls < Boys

TABLE 127

Results of Analysis of Variance for the Affect Adjective Check List Administered Prior to the Major Testing with the Instructions to Score it According to Their Usual Feelings During an Examination (Part II of the Student Survey)

Source of Variation	df	Mean Square	F
A-Instruction	3	4.57	0.13
B-Proficiency	1	22.07	0.65
C-Sex	1	315.78	9.30**[a]
A X B	3	105.26	2.10
A X C	3	61.80	1.82
B X C	1	71.02	2.09
A X B X C	3	53.83	1.58
Within	64	33.97	
Total	79		

**Significant at .01 Level

[a] Girls < Boys

TABLE 128

Results of Analysis of Variance for the Test Anxiety Scale

Source of Variation	df	Mean Square	F
A-Instruction	3	6.15	0.48
B-Proficiency	1	11.58	0.90
C-Sex	1	179.90	13.92**a
A X B	3	8.86	0.68
A X C	3	2.06	0.16
B X C	1	0.54	0.04
A X B X C	3	9.77	0.76
Within	64	12.92	
Total	79		

**Significant at .01 Level

[a] Girls < Boys

TABLE 129

Results of Analysis of Variance for the Manifest Anxiety Scale

Source of Variation	df	Mean Square	F
A-Instruction	3	0.84	0.05
B-Proficiency	1	8.98	0.51
C-Sex	1	65.82	3.74
A X B	3	10.09	0.57
A X C	3	6.86	0.39
B X C	1	0.01	0.00
A X B X C	3	58.33	3.31*
Within	64	17.62	
Total	79		

*Significant at .05 Level